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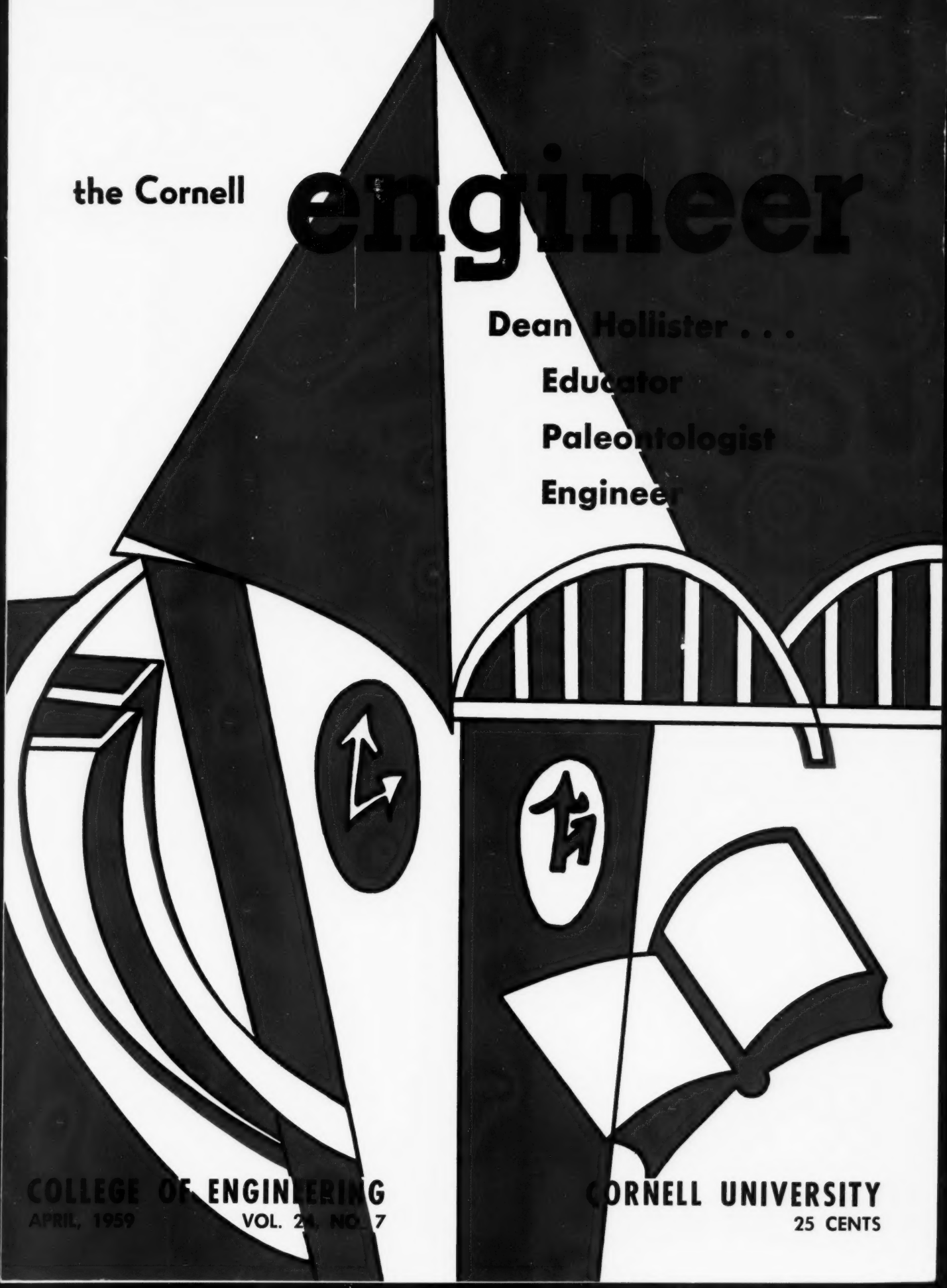
engineer

Dean Hollister . . .

Educator

Paleontologist

Engineer



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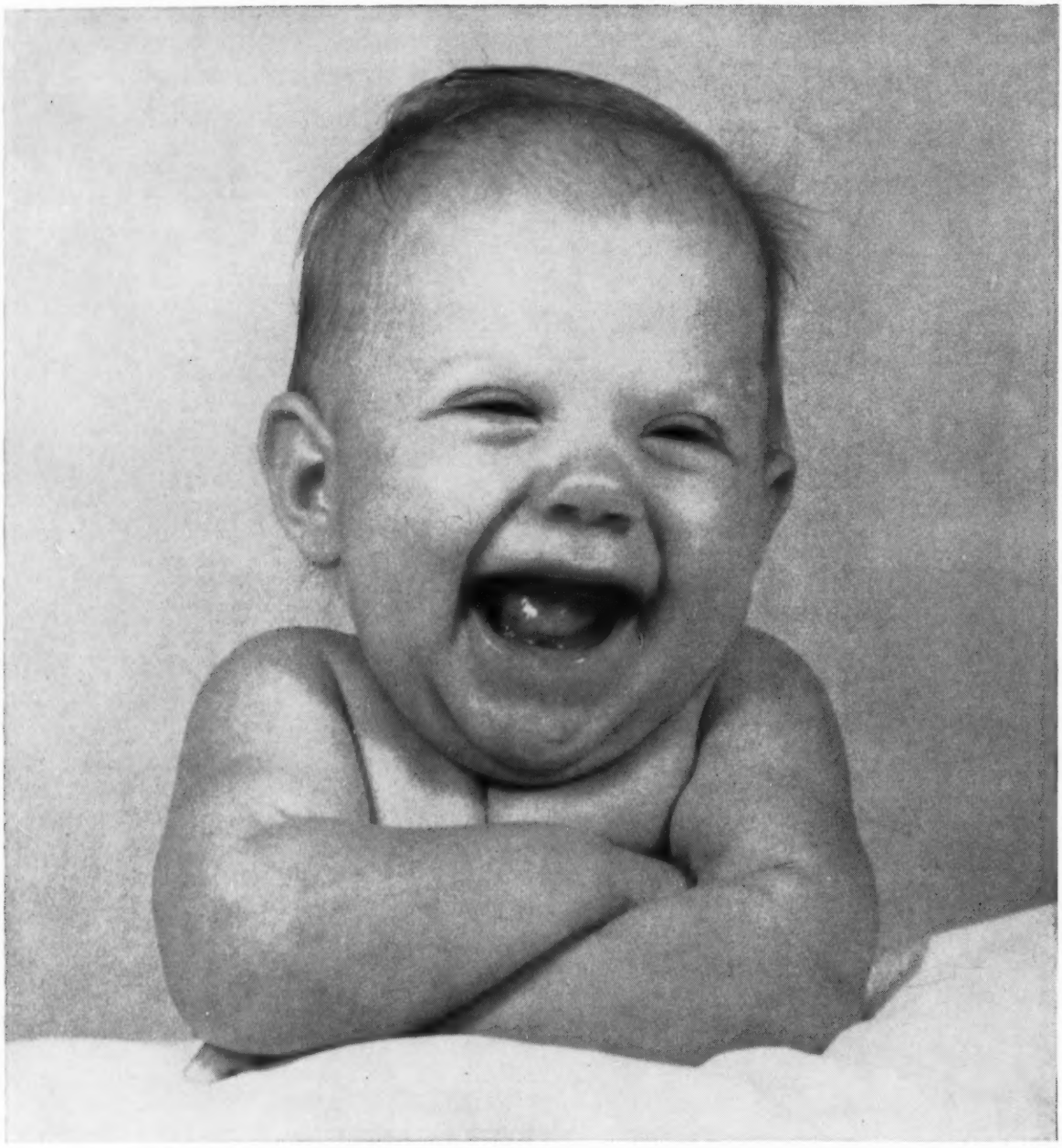

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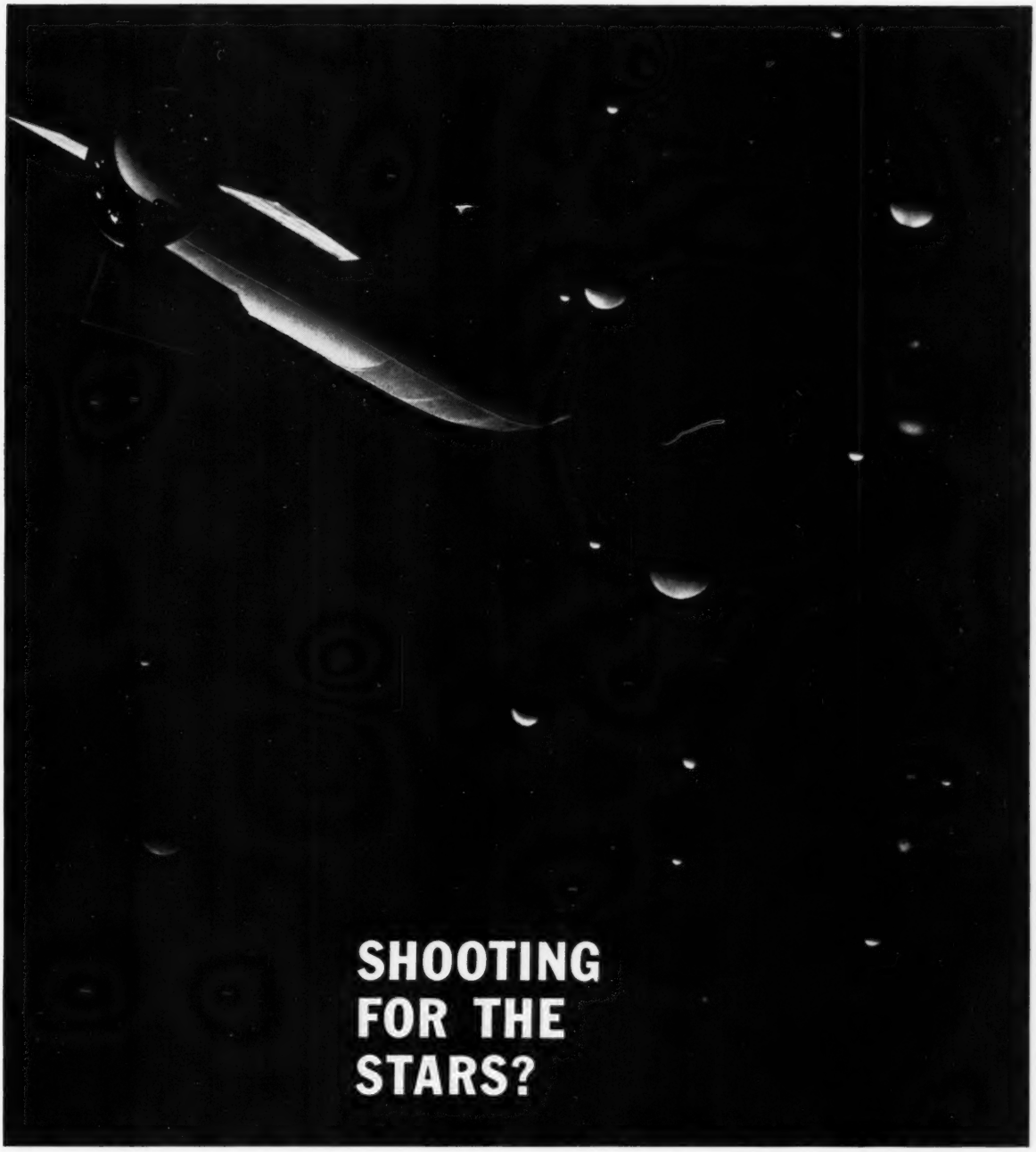

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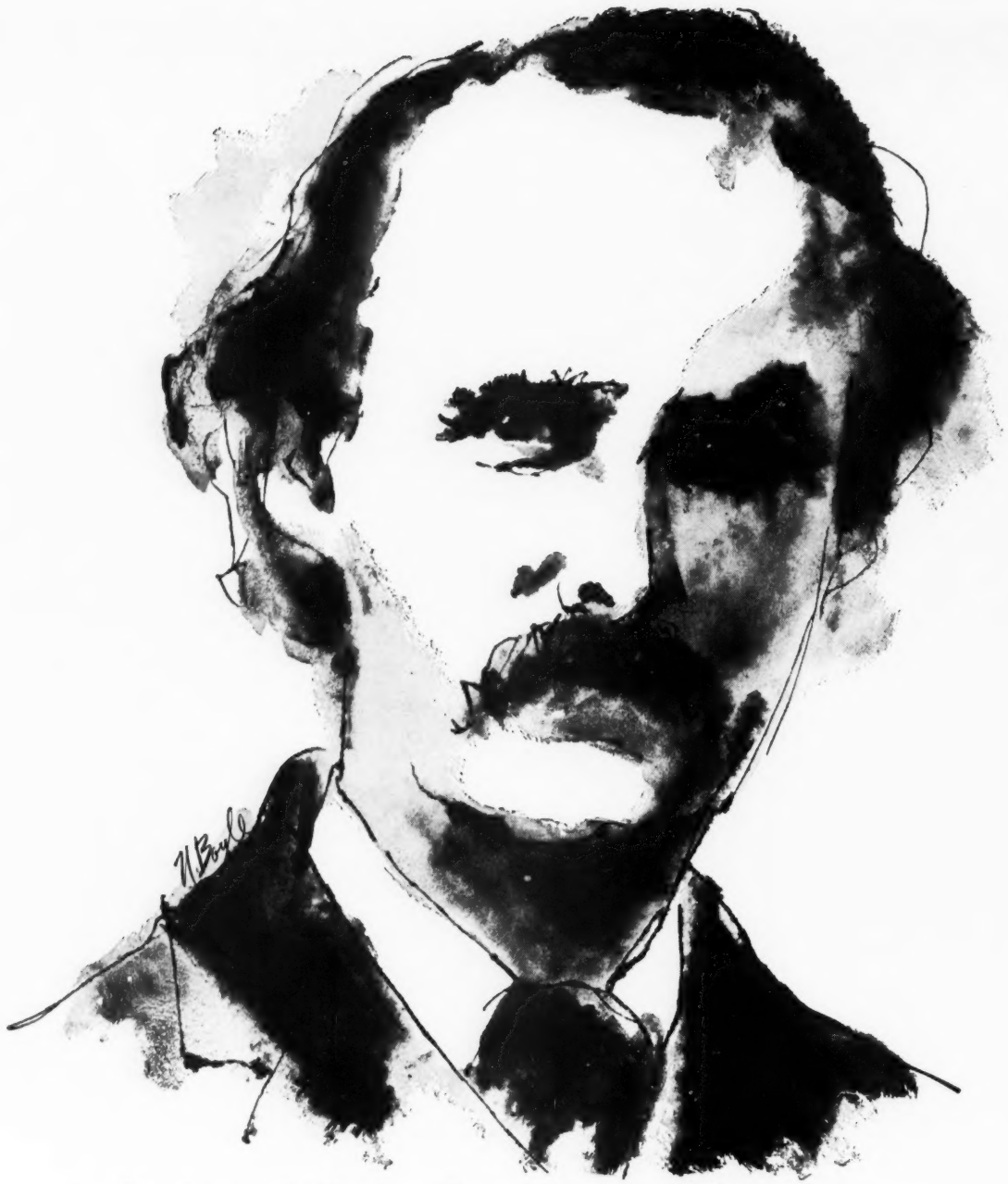

Alfred Marshall...on the tendencies of human action

"The laws of economics are to be compared with the laws of the tides, rather than with the simple and exact law of gravitation. For the actions of men are so various and uncertain, that the best statement of tendencies, which we can make in a science of human conduct, must needs be inexact and faulty. This might be urged as a reason against making any statements at all on the subject; but that would be almost to abandon life. Life is human conduct, and the thoughts and emotions that grow up around it. By the fundamental impulses of our nature we all—high and low, learned and unlearned—are in our several degrees constantly striving to understand the courses of human action, and to shape them for our purposes, whether selfish or unselfish, whether noble or ignoble. And since we *must* form to ourselves some notions of the tendencies of human action, our choice is between forming those notions carelessly and forming them carefully. The harder the task, the greater the need for steady patient inquiry; for turning to account the experience, that has been reaped by the more advanced physical sciences; and for framing as best we can well thought-out estimates, or provisional laws, of the tendencies of human action."

—*Principles of Economics*, 1892

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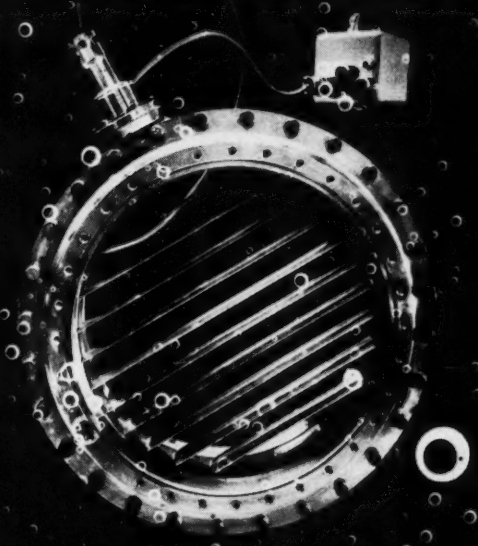

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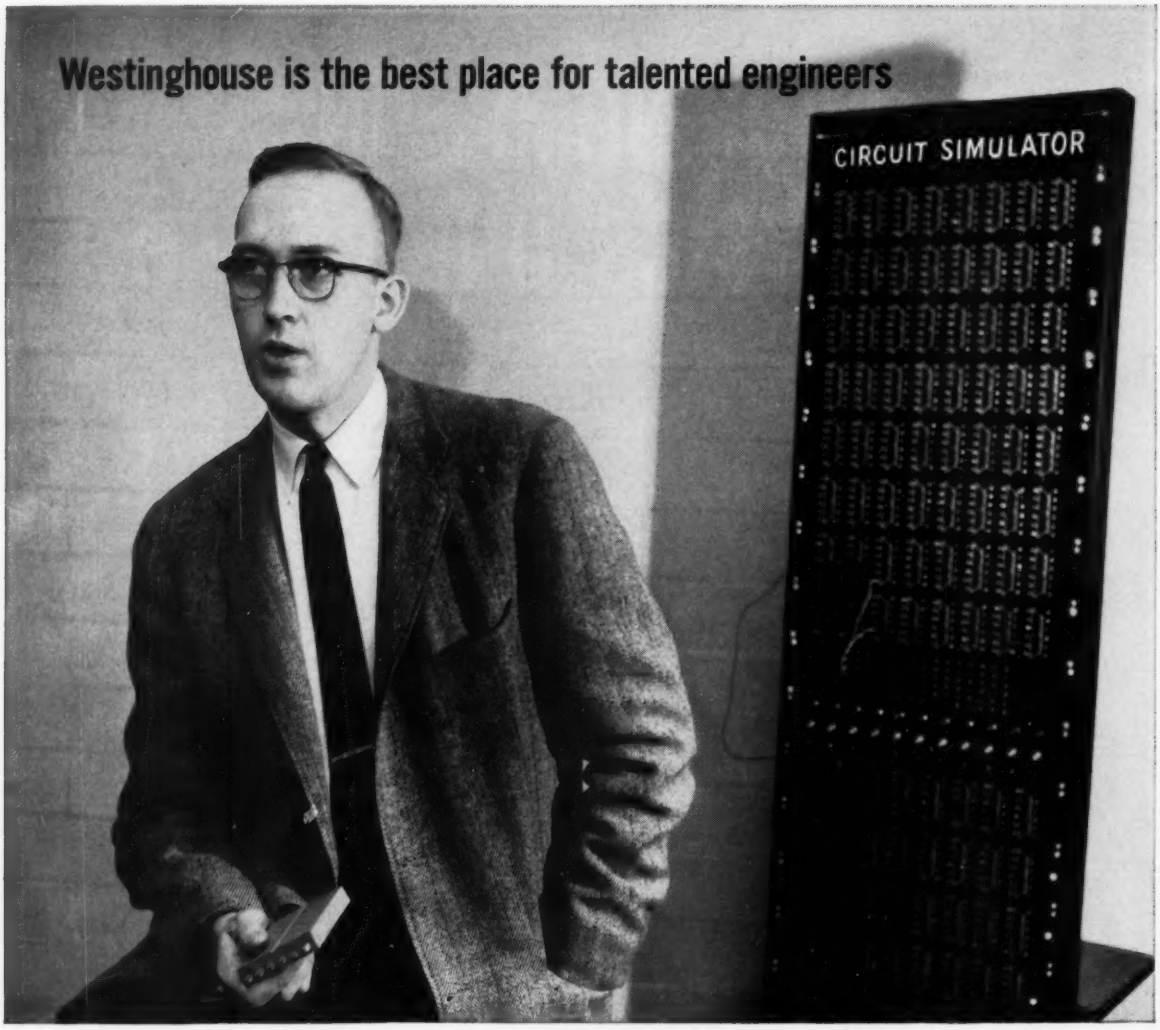

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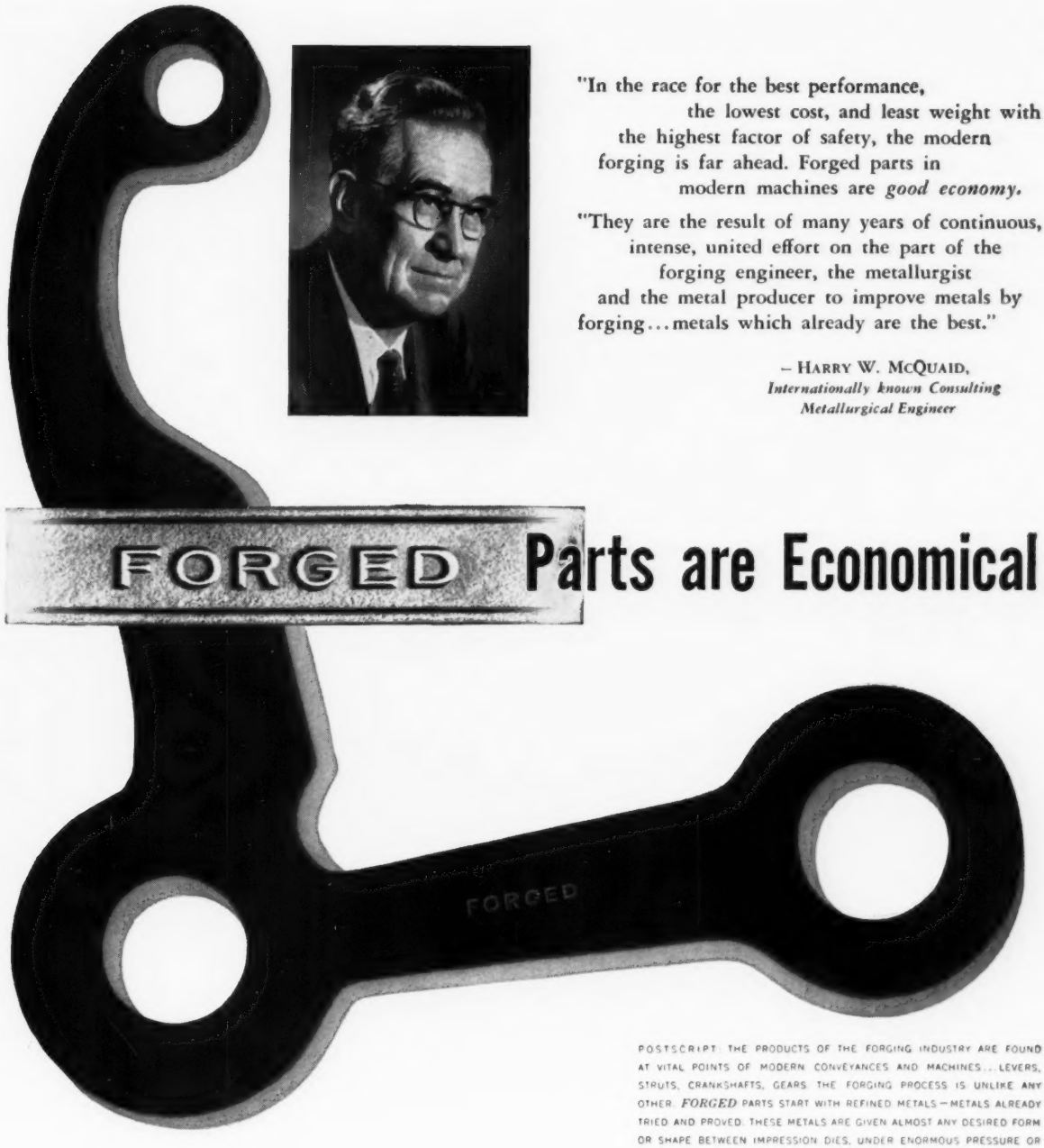

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Editorial:

TO THE DEAN . . . WITH THANKS

When a man has served as dean of an engineering school and has made it as outstanding as Cornell's, his accomplishments speak for themselves. Dean S. C. Hollister has built for Cornell an educational institution that is among the world's best.

This issue of the CORNELL ENGINEER presents sketches of our retiring Dean's varied activities. During his twenty-two years at Cornell, he has successfully guided this College through the greatest engineering advances in history. The Dean has been a key man in the initiation of many of these developments.

The Public Information Office issues a list of the Dean's many, many projects, but we, as students, will recall with thanks certain aspects of his career which cannot easily be put in writing. In an engineering school as large as ours, it is all too easy for students to become lost in masses of statistics; but it is even easier for an administration to become far removed from the problems of a student body.

Somehow, though, Dean Hollister has never permitted this gap to develop. We never cease to marvel at the fact that the office door is always open to any and all student problems. We have often been up to the office for his advice on such "major" questions as the ENGINEER cover design or the theme for the sub-frosh issue. More important, though, has been his help with our academic problems.

Students are never just "sandwiched" into the Dean's schedule. Our questions and problems have always received serious, extended attention from him.

Indeed, his deep concern for student welfare has had its profound effects. Following the lead of the Dean's office, most of the engineering schools have outstanding personalized counseling services. Each director's office is always open to students who wish to discuss personal or technical questions.

In addition, Dean Hollister has always made his personal counseling services available to parents. The effect of this policy on parent and student peace of mind has been incalculable. We are very much aware of the fact that other schools at the University would do well to model their relations with students, parents, and faculty (which are often sorely inadequate) after those established by our Dean.

While handling the personal aspects of the School in this fine manner, Dean Hollister has continually strived to maintain high educational standards in our College of Engineering. One of his principal accomplishments has been the initiation of the five-year program. More important, though, has been his work to establish and retain an outstanding teaching staff.

We feel that without the Dean's efforts in maintaining a well-equipped faculty with a comprehensive curriculum, our Engineering School could never be enjoying its present prominence. Of course, the individual school directors have played a big role in this area, but the Dean's influence has always been there.

One of Dean Hollister's greatest achievements is the new engineering quadrangle. The quadrangle—long a dream—has, largely through the Dean's efforts, been brought to reality. There can be little doubt in anyone's mind about who is most responsible for its completion. Hollister began planning it when he first took office, and, during the past twenty-two years, he has given his time and effort untiringly to assure its construction.

He has personally pored over the plans of each building, seeing that they are complete in every detail. In many cases, he has been directly responsible for the procurement of building funds.

The pride that Dean Hollister takes in the new quadrangle is certainly justified. As a tribute, the civil engineering building is named in his honor. The name of Hollister will be permanently engraved on this one structure, but his achievements will be evident throughout the school. With his retirement, the University is losing one of its greatest educators. His successor will have a fine example to follow.

We, on the ENGINEER, extend to the Dean our thanks and best wishes. We know that he will, during his retirement, make many more significant contributions to the engineering field, for, with a man of his capacity, there are always new horizons and greater goals to be reached.—A.S.R.

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engineer

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Why metals corrode...and how to prevent it

The equipment you will design most probably will have to stand up against one or more of these 6 different forms of corrosive attack:

1. General tarnishing or rusting with occasional perforations in highly affected areas.

2. Highly localized attack by pitting.

3. Cracking induced by a combination of stress and corrosion.

4. Corrosion confined to crevices, under gaskets, or washers, or in sockets.

5. Corrosion of one of an alloy's constituents leaving a weak residue.

6. Corrosion near the junction of two different metals.

HOW CORROSION OCCURS

The basic cause of corrosion is the instability of metals in their refined state. Metals tend to revert to their natural states through the processes of corrosion. For example, when you analyze rust, you will find it is iron oxide. When you analyze natural iron ore, you find it, too, is iron oxide.

In all of the six forms of corrosion mentioned above, corrosion has the same basic mechanism. It's similar to the electrochemical action in a dry cell.

The electrolyte in the dry cell corresponds to the corrosive media, which may be anything from the moisture in the air to the strongest alkali or acid.

The plates of the battery correspond to the metal involved in corrosion.

A potential difference between these metals or different areas on the same metal causes electricity to flow between them through the electrolyte and a metallic bridge or contact that completes the circuit.

At the anode, a destructive alteration or eating away of metal occurs when the positively charged atoms of metal detach from the solid surface and enter the solution as ions.

The corresponding negative charges, in the form of electrons, travel through the metal, through the metallic bridge, to the cathode.

Briefly then, for corrosion to occur, there must first be a difference in potential between the metals or areas on the same piece of metal so that electricity will flow between them. Next, a release of electrons at the anode and a formation of metal ions through disintegration of metal at the anode. At the cathode, there must be a simultaneous acceptance of electrons. Action at the anode cannot go on alone, nor can action at the cathode.

CONTROLLING CORROSION

When corrosion occurs because of the differences in electrical potential of dissimilar metals, it is known as galvanic action. Differences in potential from point to point on a single metal surface causes corrosion known as local action.

When you plan against galvanic corrosion it is essential to know which metal in the couple will suffer accelerated corrosion . . . will act as the anode in the corrosion reaction.

The galvanic series table shown below can supply this information. In any couple, the metal near the top of this series will be the anode and suffer accelerated corrosion in a galvanic couple. The one nearer the bottom will be the cathode and remain free from attack or may corrode at a much slower rate.

GALVANIC SERIES TABLE

Magnesium
Magnesium alloys

Zinc

Aluminum 25

Cadmium

Aluminum 17ST

Steel or Iron
Cast Iron

Chromium-iron (active)

Ni-Resist*

18-8 Chromium-nickel-iron (active)
18-8-3 Chromium-nickel-molybdenum-iron (active)

Hastelloy "C"

Lead-tin solders
Lead
Tin

Nickel (active)
Inconel* (active)

Hastelloy "A"
Hastelloy "B"

Brasses
Copper
Bronzes
Copper-nickel alloys
Monel*

Silver Solder

Nickel (passive)
Inconel (passive)

Chromium-iron (passive)

18-8 Chromium-nickel-iron (passive)
18-8-3 Chromium-nickel-molybdenum-iron (passive)

Silver

Graphite
Gold
Platinum

HOW TO USE THE CHART

Notice how the metals are grouped in the galvanic series table. Any metal in one group can be safely used with any other metal in the same group. However, when you start mixing metals from different groups, you may run into serious galvanic corrosion of the metal higher on the list. And the further apart these metals are listed, the worse this corrosion may be.

But, if you have to mix metals, pay particular attention to the electrical contact between them. Eliminate any metallic bridges or contacts of metal to metal that will permit the flow of electrons through them. You can do this by separating the metals physically, or by using insulation or protective coatings. Another factor is the relative areas of the metals in contact with each other. Parts having the smaller area should be of a metal with a lower listing on the galvanic series table than the metal used for the larger area.

When you plan against local action, keep in mind that the corrosion process is similar to galvanic action . . . a movement of electrons from one point on the metal to another. Naturally, the easiest way to avoid local action is to use a metal with little or no impurity . . . or an alloy with constituents that are listed closely on the galvanic series table. Local action on other metals, however, can be controlled by stopping any flow of electrons . . . such as with protective coatings. Environment, too, is a factor for consideration.

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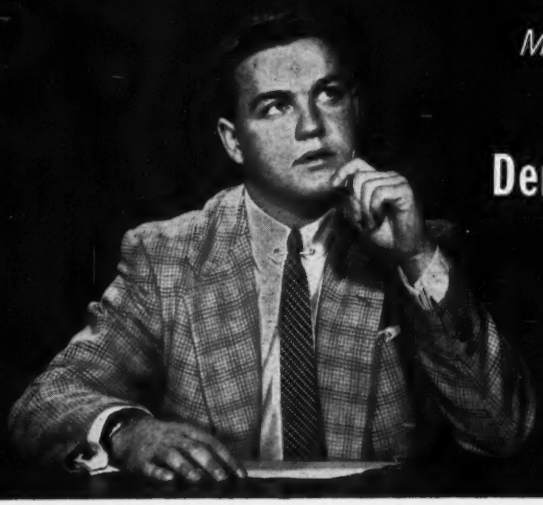

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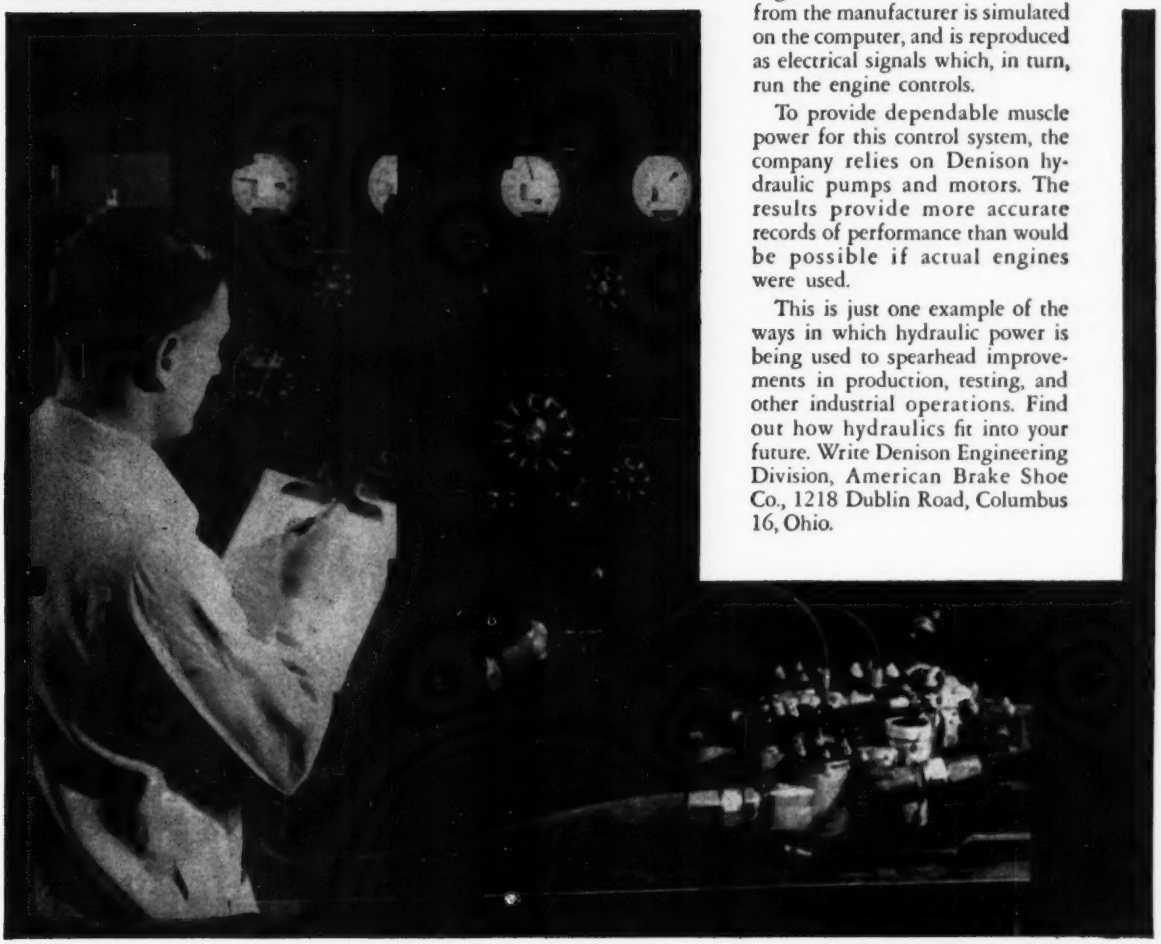

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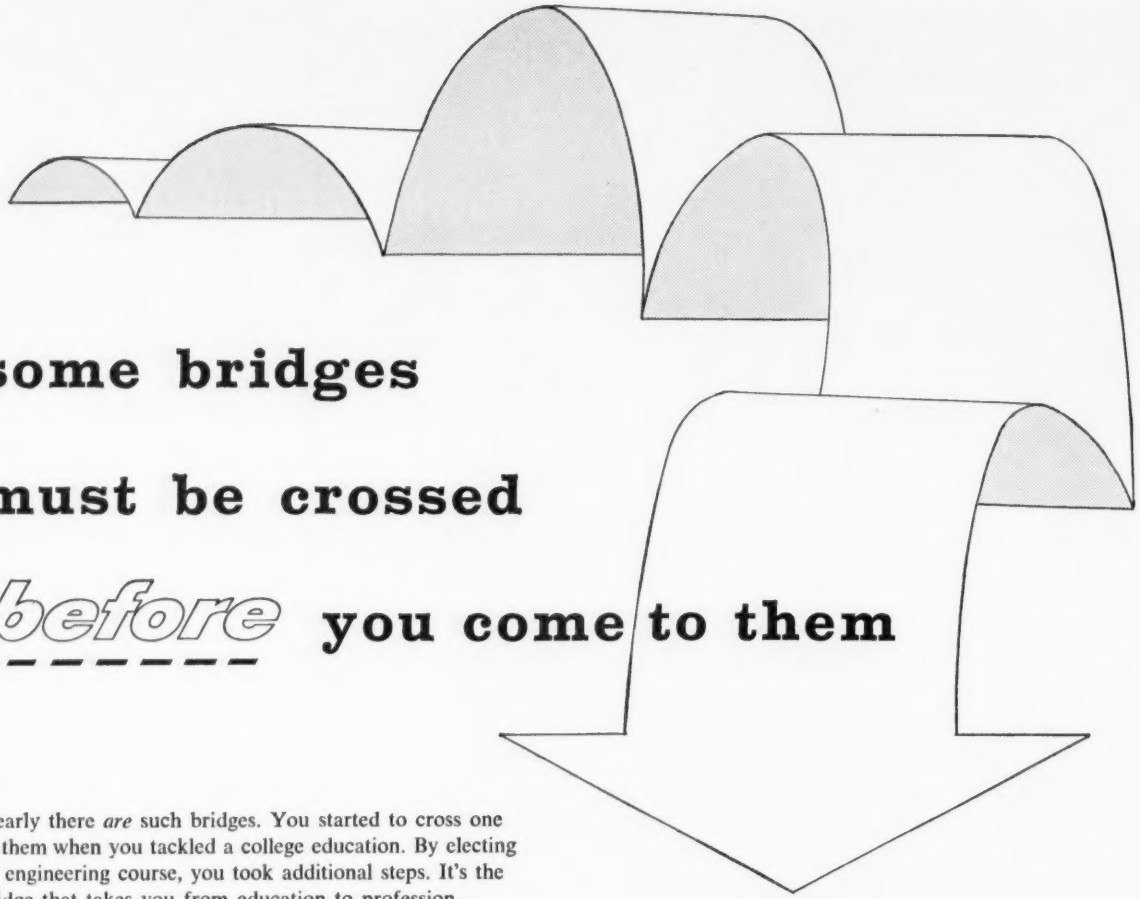

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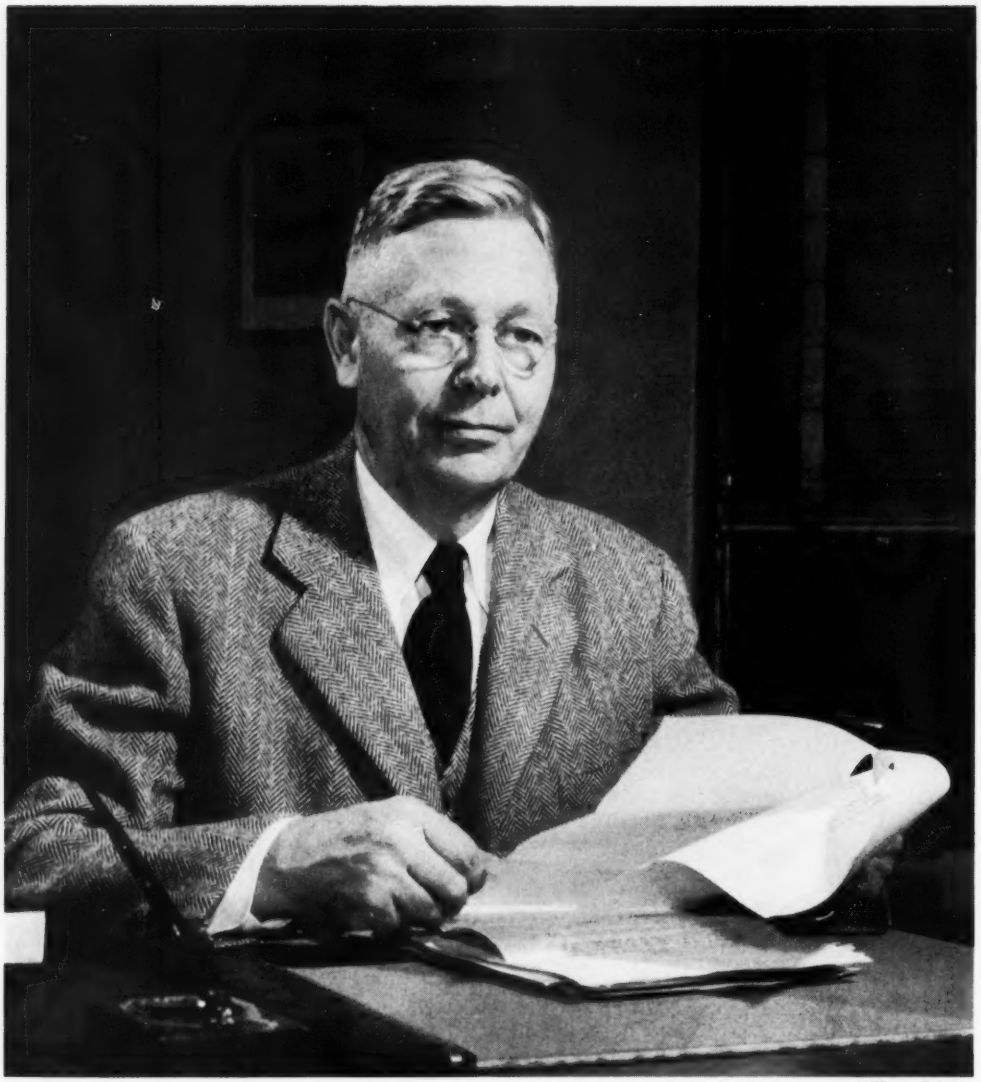

Photo Science

Dean Solomon Cady Hollister is retiring at the end of this term after twenty-two years as head of the College of Engineering at Cornell. The ENGINEER *is presenting three sketches on various phases of his distinguished career, including his contributions to education, his non-technical interests, and his professional engineering career. Each was written by a person who has been quite familiar with the Dean's work in the particular field. The purpose of presenting these sketches is not to compile a biography, but to shed light on the value and meaning of the Dean's work to those who have been associated with him.*

DEAN HOLLISTER . . .

EDUCATOR

by Assistant Dean John F. McManus

The progress of human affairs seems to move in complex cycles of long and short periods, much as do many natural phenomena. Occasionally man is able to accomplish a spurt that carries him a great distance in a short interval, as history is measured. The present technological era is surely one such rapid advance which we are witnessing firsthand.

Perhaps the outstanding characteristic of the current advance is that, for the first time in history, a massive educational impact has been applied to accelerate man's progress at an unprecedented rate. The educator, then, able to multiply his own abilities through the works of the students he sends out into society, stands at the forefront of the influences upon this great era.

Even so, it is rare for any one man to be able to participate in the achievements of his times as fully as has Solomon Cady Hollister, Dean of Engineering at Cornell since 1937, and engineer, teacher, researcher, and advisor over the full span of a professional life beginning in 1911.

The classification of "educator" is probably the most appropriate one to apply to Dean Hollister, but this is a term that must be used in a very broad sense to encompass his interests and activities. He has never been content to be restricted by the definition of a particular field, or profession, or title. A civil engineer by training, he has developed a comprehensive understanding of the extensive reaches of modern engineering in all its forms, and of the adjacent basic sciences; he has international renown among paleontologists for his research and writings in this field; and he enjoys equally the intellectual stimulation of history, philosophy, literature, economics, and the arts.

Has Gifted Curiosity

Evidence of an insatiable curiosity appeared early in his career. Not very long after starting in professional practice, he was described as follows by a prominent engineer of the day, the president of one of the major engineering societies:

"He comes into my office and starts to disclose his latest mathematical 'shortcut' (his expression, not mine) in structural design, using a jargon of mixed Greek, Roman and Hindu symbols, the prelude to aspirin. In a few minutes he has switched to 'livable' concrete houses, of which he has architected not a few, and thence to his latest concept of the essentially colloidal action of hydrating cement; to tests of transit mixers and to studies of wind torques and pressures on models in wind tunnels. His is the gift of a colorful, spritely, omnivorous mind, looking at old concepts and practices in new and illuminating ways."

Looking at old concepts and practices in new and illuminating ways—this was not merely a comment on the zealousness of the young practitioner, but recognition of a characteristic that Dean Hollister has applied to the many and varied situations that have come before him over the years. To most persons – even most engineers – concrete is a material used for roads, bridges, buildings, and dams, but to engineer Hollister it was the material of ships as well. During both World War I and II, when steel supplies became critically short, he played a prominent part in the design and construction of concrete ships for war service. Similarly he championed the development of structural welding, when little was generally understood of either the theoretical design principles or the techniques of fabrication. His studies in this area brought him the assignment as consultant on the design and construction of the thirty-foot diameter welded penstocks at Hoover Dam, one of the great achievements in structural welding. He has since been called into consultation on a number of complex designs for high-temperature, high-pressure boilers and pressure vessels.

Dean Hollister has brought this same kind of approach to engineering education—not advocating change for the sake of change, but restating the fundamental purposes of the established concepts of education and then proposing the means for accomplishing these purposes in terms of modern requirements.

At the time Dean Hollister entered the academic world, as an instructor in mechanics at the University of Illinois, engineering education had taken on a rather conventional and uniform pattern that had been essentially stable since the 1890's. It had served the profession well, for it had prepared several generations of engineers who had carried out the great development of American industry, transportation, and communications that achieved an unprecedented wealth and standard of living for the nation. Nevertheless

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About the Author

When Dean Hollister came to Cornell in 1934 as Director of the School of Civil Engineering, Mr. McManus was a student in that School. The student-teacher friendship that developed at that time was maintained over a period of years during which Mr. McManus engaged in engineering practice in industry. Dean Hollister invited him to return to Cornell in 1948 as his administrative assistant. Since 1956 he has been Assistant Dean of the College of Engineering.

it became apparent to some that technology was outdistancing the educational processes on which it was based. Obviously a curriculum constructed in large part of the study of standardized practices might adequately prepare students for evolutionary progress, but technology was clearly entering upon a revolutionary era.

For more than forty years Dean Hollister has been part of a small vanguard of engineering educators giving leadership to developments in curricula, educational methods, and attitudes bearing upon the advance of modern technology.

During the past twenty-five years, he has been developing his concepts of engineering education in association with the College of Engineering at Cornell, first as Director of the School of Civil Engineering, and since 1937, as Dean of the College. He has been the latest in a line of distinguished educators who established the College in a preeminent position in the field within two decades after its founding. Such a position is not secure simply because of tradition —it requires periodic self-evaluation and revitalizing if it is to be held. Cornell, like many other institutions, faced a number of major crossroads decisions in the mid-30's, at the time of Dean Hollister's appointment.

Cornell Required Modernization

The nation had experienced a major war, followed by a rather confused period of readjustment, and then a serious and extended depression. Super-imposed on these complex factors was the imminence of an unprecedented technological advance. For Cornell there was the further urgency of meeting the need for expanded and modernized engineering facilities—a need that had been recognized and projected by College authorities shortly after the turn of the century. In the interim some planning had been carried out, but the disruptions of the times and the general situation of the University made impossible any real accomplishment.

The challenge to education in the technological era ahead, and specifically the challenge to Cornell, formed the framework of Dean Hollister's assignment. The achievements of the College during his tenure, in both educational and physical development, surely constitute one of the most significant chapters in the history of engineering at Cornell.

Academic change and academic progress are the work of faculties, of course, and Dean Hollister would be the first to insist that in the many advances made at Cornell in recent years, his part was that of a "catalyst." A catalyst in this sense is no passive agent, however, and it is certain that over the years he has stimulated—and even provoked—a great deal of thought and action, among both his own colleagues at Cornell and educators across the land, on the aims, the functions, the responsibilities, and the methods of engineering education.

The present-day curricula of the College embody many of his personal views. As has been traditional at Cornell, they cover the range of engineering practice in terms of the major fields and are not splintered into the multitude of narrow specialities within these fields. The most distinguishing characteristic, the five-year span for the undergraduate program, provides for the essential elements of engineering study strongly advocated by him for many years: (1) a broad and deep foundation in the basic sciences; (2) a common background in fundamental engineering studies for all students; (3) time for a sequential arrangement of courses so that advanced subjects can be strengthened; (4) time for an adequate range of engineering applications, both in course work and in individual projects, to develop competence and initiative for engineering practice; (5) and provision for development of individual interests in liberal and general studies as a background for cultural growth throughout life.

Now a curriculum, and a philosophy, are no more than words on paper until they are given substance by a faculty, and a student body, and a nourishing intellectual climate. Dean Hollister's success as a builder has been in this area as well as in the stone and concrete of the new Engineering Quadrangle.

Develops Talented Staff

At the time he assumed office, the College faced a considerable depletion of its faculty from the retirement of a number of senior staff members. Since relatively few

Pete Gaalaas

Dean Hollister is talking with several fifth-year engineering students; Frank F. Walsh, John M. Walsh III, and William Powell.

C. Bradley Smith

At the dedication ceremony for Phillips Hall, Dean Hollister is shown with Mr. Phillips, Mrs. Phillips, and President Mallott

junior staff had been appointed during the depression years, there was little internal growth possible, so the problem was one of bringing into the faculty a group of highly qualified persons in a rather short period of time.

While in some respects this gave an opportunity for rapid strengthening of the faculty, the combination of professional talents, personality, and leadership abilities sought limited the possibilities to a rather distinctive few. The roster of the College faculty of recent years and the record of its achievements attests to the development of a staff that stands alongside the great faculties in Cornell history, and one that has contributed a major advance in Engineering at Cornell.

Paralleling faculty development has been an impressive growth in graduate study and research. Here also Dean Hollister has advocated a philosophy that stems from fundamentals. He has stated often that the various components of an educational program should be complementary and not isolated. Engineering research, and direction of graduate studies are carried out by a faculty which is also directly involved in undergraduate teaching, so that there is a feedback into the undergraduate programs of the vitality and vision of advanced activities. Undergraduate teaching has always been a primary function of the College and it remains so today, but it is seasoned with the dynamics of front-line work in the new areas of technology.

His accomplishments at Cornell and in the engineering profession have brought Dean Hollister numerous assignments in educational, professional, and public agencies. As a member, and then chairman, of the Education Committee of Engineers' Council for Professional Development, he proposed a statement on "Minimum Essentials of an Engineering Curriculum," which was not quantitative but philosophic—a restatement actually of the basic objectives of engineering education in terms of the expanding responsibilities of the profession. It was a banner he had carried since his earliest days in engineering education, a quarter-century before. This stimulated the appointment of a commission of representatives from education and the profession to study engineering education on a national scale, to coordinate a vast program of self-evaluation by engineering schools, and to develop a comprehensive platform of basic requirements from which schools could progress according to individual design.

Defines Engineering Education

A further development was sparked by an address given to Engineers' Council for Professional Development at its annual meeting in 1955, when he put forth his "Proposal for a Survey of the Engineering Profession." He reasoned that, in order to properly direct the future of engineering education, it was essential that the future of the profession itself be defined—its functions in an expanding technology, its relations to social, political, and economic development, its general structure in an increasingly complex society. This proposal has had wide discussion throughout the profession and the means to be taken to implement it have been under study by a committee from both inside and outside the profession.

The role of the engineer in the total economy of the nation has attracted much of his attention. In one paper he remarked:

"Recently I read an article in which a leading industrialist agreed that our natural mineral resources are inexhaustible, needing only improved methods of exploration, discovery, extraction, and processing, supplemented with development of synthetics. Apparently he did not recognize that the inexhaustibility he was depending upon was largely the inexhaustible ingenuity of engineers.

"It is the responsibility of assuring this inexhaustibility of engineering resource that concerns us in engineering education. We as educators must address ourselves more assiduously to the task of developing in our students their imaginative, creative ability to a higher level than we have achieved in the past."

Dean Hollister was one of the early advocates of a stronger science background for engineers, but he spoke also for a clear understanding of the differences in objectives between the two fields. In a paper, "Importance of Engineering Science on the Future of the Profession" he stated:

(Continued on Page 33)

Photo Science

Mr. McManus and the Dean are shown in the latter's office.

DEAN HOLLISTER . . .

PALEONTOLOGIST

by Katherine Van Winkle Palmer, Ph.D '25

Dean S. C. Hollister

The common Atlantic "left-handed whelk" was erroneously called *Busycon persersum* for about 180 years. That was a name given by the great Linneaus for a different shell. Following that time the shell was called *Busycon contrarium* but that name was also for another shell. The name in each case indicating the opposite coiling from normal. Hereafter the snail becomes known as *Busycon sinistrum* Hollister, the "left-handed whelk."

"The mistake I made was to buy a book," Dean S. C. Hollister facetiously once said when discussing his hobby of shell collecting. This hobby has become a study.

In 1942, Hollister was on his way to Florida to convalesce. He carried with him Perry's *Marine Shells of the Southwest Coast of Florida,* an introduction to the mollusk life of Sanibel Island. That introduction led to beach combing and dredging for shells. It led to the wharves where shrimp boats come in with their haul of shellfish and, more glamorously, with the rare mollusk from depths beyond the strand. It led, when possible on vacations and convenient business trips, down the Florida Keys to the Dry Tortugas, to the shores of New England, Virginia, the Carolinas, Alabama, Mississippi, Texas, and California. It led to friends of mutual interest who had previously known the fascination of shell collecting and to those who had delved deeper into the history of animals—the diggers of fossils. It led from searching for more and finer shells along the beaches to the fabulous store of fossils on the banks of the Caloosahatchee River, eastward from Fort Myers, Florida.

With pick, shovel, knife, and strainer, along with bottle, paper, and boxes, Dean Hollister patiently combed the sands of the river bank for the fossils which during some 15 millions of years (Pliocene in age) had been preserved in magnificent condition. With typical concentration, enthusiasm, methodical planning, and determination, the engineer became absorbed in the problems connected with the mollusks which are living today and with the fossils of yesterdays—problems of names, characters, distribution, ecology, and relationships.

When the vast number and variation of the group of animals, clams and snails, became apparent to him through his continued interest and study, Dean Hollister picked from the array of marine gastropods (snails) two forms to investigate. Their names, distribution, and geologic history were challenging to an inquiring mind. Both are conspicuously abundant animals living along the Atlantic Coast and the Gulf Coast to Mexico and are equally numerous amongst the fossils. Each had complicated, controversial problems of nomenclature, shell features, and range of species. With the same thorough method of logical attack as used in the design of the construction of a bridge, he forged into the maze of historical literature and the biological problems of anatomy and distribution connected with the study of these creatures, commonly known as whelks, *Busycon,* and tulip shells and horse conch, *Fasciolaria.*

His research, during intervals snatched from a strenuous academic and administrative life, led him to collections in museums, university departments, and biological stations from south, east, and west. He would frequently consult with fishermen, amateur shell collectors, shell dealers, students, and authori-

(Continued on Page 35)

About the Author

Katherine Van Winkle Palmer, Cornell, Ph.D., 1925, is Director of the Paleontological Research Institution, Ithaca, New York. Specializing in fossil mollusks, she has served on the International Commission for Zoological Nomenclature, and has had published by the Geological Society of America, a memoir on living Pacific Coast mollusks.

DEAN HOLLISTER . . .

ENGINEER

by J. Carlton Ward, Jr., M.E. '14

It is a great challenge as well as a privilege to write about Dean Hollister. Many years of close association with him during the period of his Deanship of the College of Engineering at Cornell have only emphasized the many facets of his character and the many fields of his competence.

Perhaps his outstanding characteristic is the breadth as well as depth of his knowledge in so many fields of human interest. How many know him as a great paleontologist? Do many of his friends know that the Smithsonian Institute in Washington, D.C. regards him as one of the top authorities in this field? How many know him as a collector of original source material in the field of the history of mathematics?

But, it is his professional achievements in civil engineering that first brought recognition and led him into the academic scene. He has played a leading role in this field since early in his career, when he was eager to bring scientific insight into the practical problems of structural design in complex structures fashioned from heterogeneous materials. He was instrumental in applying photoelastic analysis when it was a new technique to the problems of stress and strain. Reinforced concrete construction was in its infancy when his interest helped unfold the field into a predictable science. He helped realize the potentialities of stuctural welding. His research on the transit mixer became the basis for modern concrete mixing specifications.

Consultant on Hoover Dam

A brief review of his accomplishments reveals the fact that during the 1920's, he was consulting engineer on over $20,000,000 worth of building construction. In addition, he was designer and builder of thirty concrete bridges, and he prepared designs for the strengthening of five swing bridges and three railway bridges by welding. As an authority on structural welding he worked as a consultant on the Hoover Dam penstocks in 1932. At present, he is Chairman of the Board of Consultants, Isthmian Canal Studies exploring a means for enlarging and modernizing an Atlantic-Pacific canal route.

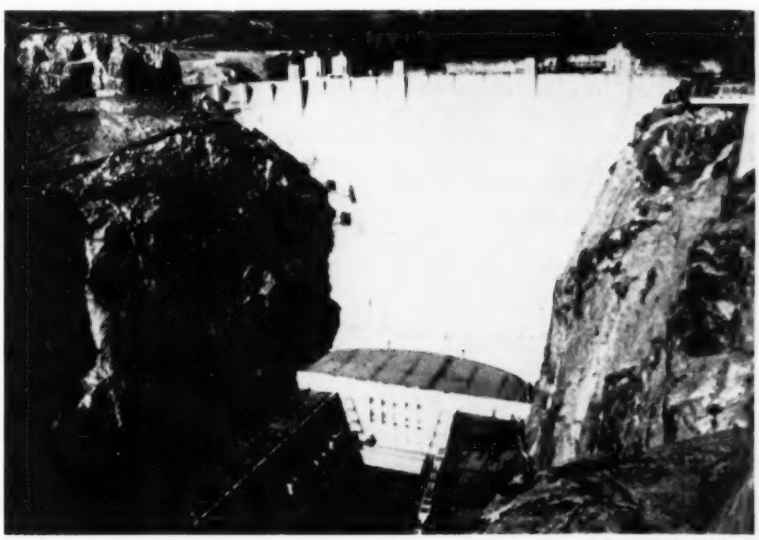
Dean Hollister's civil engineering background has had much influence on the many projects which he originated and carried out while at Cornell. The University has been most fortunate that he has guided the construction of its new engineering buildings, using his professional competence to bring about economy of design, blended with pleasing architectural treatment. This resulted in cost savings that stand out as models in the vast new construction program at the University since World War II.

Dean Hollister developed the idea of translating the Curtiss-

(Continued on Page 40)

About the Author

J. Carlton Ward, Jr., president of the Vitro Corporation of America, has had close association with the University and the College of Engineering during much of the period of Dr. Hollister's deanship. As a member of the University Board of Trustees, and as chairman of the advisory council for the College and the Engineering College Council, he has participated in the consideration of many phases of the development program proposed for the College by Dean Hollister. His activities on various industrial and governmental boards has brought him into contact also with Dean Hollister's professional and public services.



Dean S. C. Hollister

Dean Hollister was a consultant in the design of the penstocks of the Hoover Dam in Colorado.

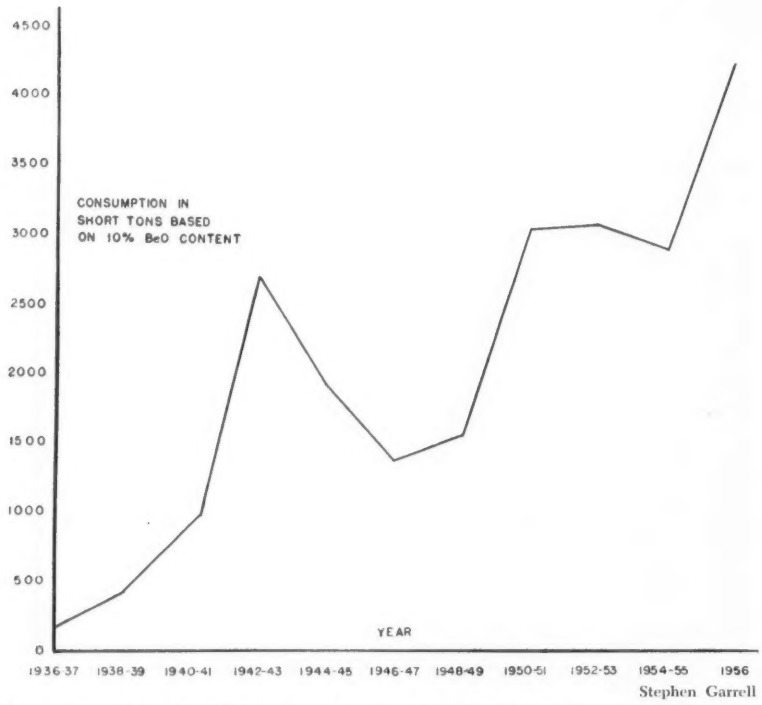
THE FUTURE OF BERYLLIUM

by A. Callaway Allen, Jr., ChemE '59

From an untried, almost unknown metal before World War II, beryllium has become a strategically important defense material with a promising future. Beryllium has had two fields of application, the metal and the oxide. The metal has a twenty-five year history in the alloy field, particularly as a copper alloy. More recently the pure metal has become important in nuclear applications because of its excellent performance as a moderator and reflector in nuclear furnaces.

The oxide of beryllium is one of the best refractories and is able to withstand extremely high temperatures, while having relatively high thermal conductivity and excellent thermal shock resistance. Beryllium oxide is used in both nuclear and general refractory applications.

The element beryllium was discovered in 1797 by Vanquelin. For many years there was very little knowledge about it. However, the desirable alloying characteristics of beryllium were discovered, and in 1936 it began to have industrial importance as an alloy. Since 1936, the growth of the beryllium industry has been very sporadic. Because of its strategic importance, the demand for beryllium was greatly increased during World War II and the Korean War. Wartime uses and research were altered to peacetime applications, and after each war, peacetime consumption was at least 200 percent greater than before the war.



Graph one: United States Beryllium Consumption Average in short tons for two year periods.

Uses

Beryllium was first used as an alloy metal, and since 1936, over 90 percent of the beryllium has been for alloying purposes. Beryllium-copper alloys have been by far the most important ones and have comprised the greatest single usage of the metal. The copper alloys are of commercial and strategic value because of their hardness, tensile strength, high electrical and thermal conductivity, low creep tendency, low-sparking and non-magnetic properties, and resistance to fatigue, corrosion, and wear. These properties have caused wide use in the electronic and aircraft industries. The following table presents the breakdown for the strategic uses of beryllium-copper alloys during World War II and the peacetime uses since then.

TABLE

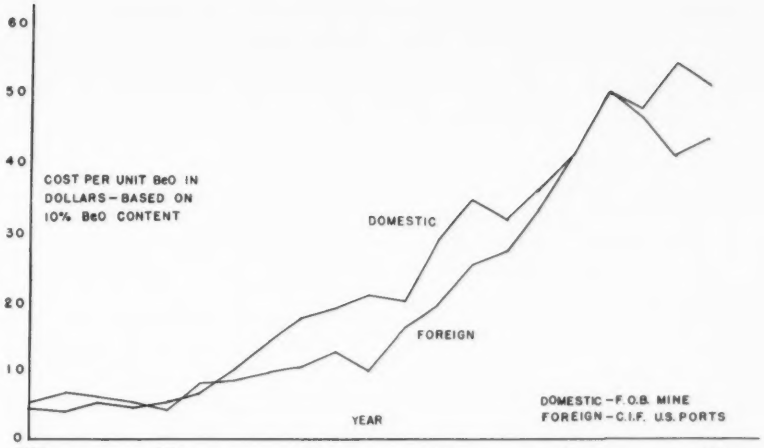
Aircraft	50%
Radio and Radar	15
Navy	15
Misc. Army	12
Research	5
Miscellaneous	3
	100

Electronics & Comm.	20%
Electrical Manufacturing	16
Business Machines	16
Refrig. & Air Condition.	10
Foundries	8
Automotive	8
Welding	6
Aluminum Industry	5
Non-sparking Tools	5
Miscellaneous	8
	100

Since 36 percent of the beryllium-copper alloy consumed goes to the electronic and electrical industry, an even greater demand is expected, due to the rapid growth of these fields.

Beryllium metal has had limited use in the nuclear field as a moderator and neutron reflector in nuclear reactors. Beryllium's great strength at very high temperatures combined with its ability to act as a moderator or reflector make its potential consumption in nuclear applications very great. However, at present the cost and machinability of beryllium limit its usage, and unless nuclear power becomes economical more quickly than predicted, this potential demand will not be realized soon.

The chief demands for beryllium oxide are also in the electronic and nuclear fields. The high thermal shock resistance, extremely high temperature resistance, and thermal conductivity will increase the demand for BeO as advancements in these industries require higher and higher operating temperatures. However, BeO constitutes a relatively small part of the beryllium industry, and changes in the rate of consumption of BeO will not greatly affect the industry. Minor uses for the oxide include, a component for special glass, 'getters' in radio tubes, and catalyst for dehydrogenation processes.



Stephen Garrell

Graph two: Average price per unit beryllium oxide domestic and foreign sources.

Cost and Production

The rate of increase in consumption of beryllium is the most important aspect of the industry today. The cost of beryllium is very high.

In the late forties, beryllium metal sold for $100 to $150 a pound. After the AEC plant built in 1957 began operating, the cost of beryllium dropped 50 to 60 percent. By placing contracts in 1956 with private industry, the AEC obtained another reduction of 15 to 20 percent on the cost of beryllium metal. In other words, when the government substantially increased the quantity purchased, industry was able to further reduce the price of beryllium to one-third that of 1951 levels. In March 1958 beryllium cost forty-seven dollars a pound for billets and sixty-five dollars to eighty dollars a pound for hot-pressed or rough machined blocks. Estimates are that if in addition to 1958 consumption, an additional 200,000 pounds of beryllium were required the price could be cut another 15 to 20 percent.

By plotting the average consumption of beryllium for two year periods against the time and calculating the slope of the best straight line, it can be shown that consumption of 10 percent BeO ore had increased at the average rate of 200 tons per year since 1936. This is equivalent to 7.4 tons per year of beryllium metal. At this rate of expansion it will take 13.5 years for the industry to reach an additional 200,000 pounds per year consumption level. Nor is this method of predicting the growth rate of the beryllium industry very misrepresentative. It must be remembered that beryllium was virtually untried before World War II and the wartime research was largely applicable for peacetime uses. Barring another war crisis, the expansion of beryllium in *present industrial* uses will probably approximate this overall growth rate.

Since the Korean War, the demand for beryllium has increased markedly. The greatest reason for this was because of government interest in the nuclear uses for beryllium. This demand in all likelihood will not continue unless nuclear power should suddenly become economical. Therefore, the post-Korean war increase in consumption is somewhat inflative.

Technological advances in the beryllium industry do not promise much reduction in cost. These advances have just kept pace with the rising cost of beryl ore so that reduction in production costs have balanced increases in ore costs to keep the product prices relatively constant. Ore costs have increased 300 percent since 1946. This largely reflects the rising labor cost in hand-sorting the ore. This labor cost is the primary reason that imported ore is cheaper. Mechanical or flotation separation of the ore is not easily accomplished and will probably remain uneconomical until ore demands are greatly increased.

New Applications

Experts hope for a much greater increase in the demand for beryllium than can be predicted from present uses or growth. This hope is largely based on the potential non-nuclear applications for the metal.

The most promising non-nuclear use for beryllium is in the aircraft and missile industry. Since it is the only lightweight metal with a high melting point and high modulus of elasticity, it is the best metal available to solve the re-entry problem for missiles and space-ships. With the space age here undoubtedly this demand will increase. It is estimated that for airplanes of similar design, a beryllium aircraft would be 48 percent lighter than an aluminum one. This would result in amazing savings to airlines and the government in fuel costs.

Besides structural parts in airplane bodies, other future uses may be: parts for X-ray cameras, high-speed cameras, aircraft brake parts, underwater instruments, accelerator targets, gas turbine engine parts, high frequency electronic parts, aircraft instruments, beryllium additives to aluminum, zinc, and other alloy melts, high velocity testing equipment, beryllium additives to steel, rotor shafts in refrigeration equipment, and rocket engine components.

On a more theoretical basis beryllium has been considered for a solid fuel. It is second only to hydrogen for heat yield rating. However, it probably will not be used for a long time.

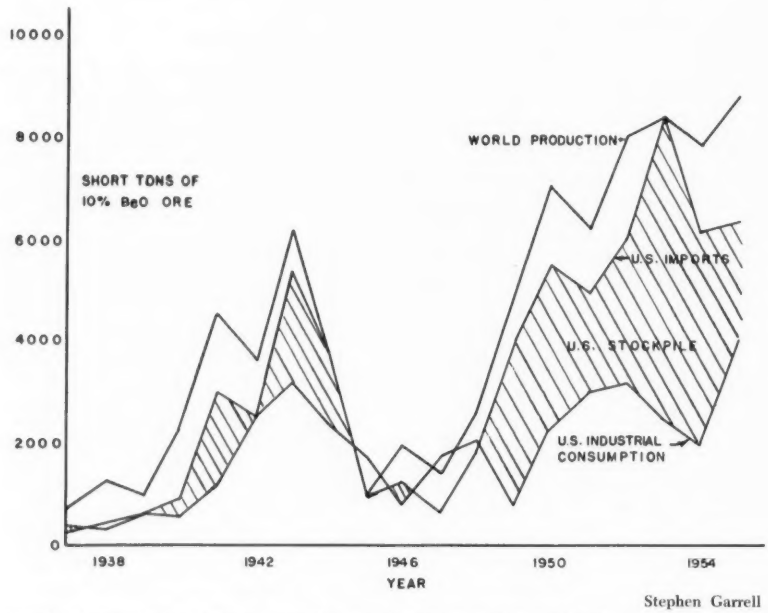
There are five problems limiting the immediate realization of these potential uses. The price of beryllium makes it economically unfeasible in comparison to many of its substitutes. The problem of the relation of cost to production has already been discussed. The other problems are availability, ductility, and toxicity.

Availability

The biggest question mark to the future of beryllium is its availability. Beryllium only comprises about 0.0006 per cent of the earth's crust. Industrial grades of ore contain about 10 per cent BeO, but such grades are seldom found in large enough quantities to make it economical to mine BeO for its own sake. Therefore, most beryllium ore is obtained by by-product mining, usually of feldspar or mica.

The reserves of 10 per cent BeO are dwindling and new methods of low grade ore concentration must be developed to meet the present demands, much less the requirements of the potential uses. Lower grade reserves have been increased recently in Brazil and in the United States. Research is being done to make mining of the tinspodumeme ores in North Carolina economical. This North Carolina deposit is estimated to contain 823,000 tons of beryl. Flotation methods have to be employed, however, to concentrate the ore.

Regardless of this new deposit the United States will remain heavily dependent on imports for supply. United States production of ore has been only about 7 per cent of the total world production, whereas U.S. consumption is 90 to 95 per cent of the world consumption. Fortunately, the major producers, Argentina and Brazil are friendly to the United States, but with 90 per cent of the United States' supply dependent on imports and with the touchy political situation in the world today, sources for beryllium are not too secure.



Stephen Garrell

Graph three: United States imports in relation to world production and industrial consumption.

Even if the importing is not affected appreciably, the availability of beryl for industrial uses is limited. Graph III shows that although total U.S. consumption of ore was nearly as great as world production, the industrial consumption was much smaller. The difference is the ore that goes to the national stockpile, principally for alloy reserves. Since 1951, stockpile storage has about equaled industrial consumption, and in 1956, 2.8 times as much beryl was stockpiled as was used. This means the government largely controls the beryl supply and the industrial consumer has carefully controlled, limited resources on which to depend. Needless to say in times of political stress this supply may be cut considerably.

Availability of the ore does not appear to be improving rapidly, and the uncertainty of supply will greatly hinder expanded uses of the metal.

Ductility and Toxicity

The low ductility of beryllium is the chief drawback to structural applications of the metal. Its brittleness prevents fabrication by standard methods such as rolling and extrusion. The brittleness also lessens the machinability of the metal. All beryllium parts must now be manufactured by a powder metullurgy process. This procedure requires that the beryllium 'beads' or billets from the reduction process be ground to fine powder and then cast under low pressure and high temperature. This casting method limits the number of uses in addition to greatly increasing the cost of beryllium parts.

Beryllium cannot take three-dimensional stresses because of its brittleness. This prohibits its wider use in airplane parts. Attempts have been made to reduce the brittleness by alloying, but so far none have been successful.

For many years the toxicity of beryllium was an important consideration in the use of beryllium. Prolonged contact with the metal caused skin irritations, and beryllium dust caused lung and throat irritations. The fumes from the fluoride reduction process were a constant source of worry to the

(Continued on Page 33)

MEASURING RADIOACTIVE FALLOUT

by Donald J. Martin, EE '62

Before the era of the atomic bomb, man had no control over the amount of radiation in the atmosphere, and therefore, he was not concerned with its effect on his health. When atomic explosions became numerous, however, doctors and scientists began to wonder what increase in radiation had taken place and what effect this added source of man-induced radiation had on human health.

In 1956 the Radiation Surveillance Network was established to measure radioactivity levels in all parts of the country in order to answer these questions. The network now consists of forty-five sampling stations spread across the country including Hawaii and Alaska. Most of these are operated by personnel supplied by the Department of Health of the state or territory in which the station is located. The Division of Biology and Medicine, United States Atomic Energy Commission, provides funds and equipment in cooperation with the Division of Radiological Health, Bureau of State Services, Public Health Service, which administers the network, and which provides the central laboratory and clearing house.

Three Measurements Taken

At the sampling station three measurements are taken: the environmental gamma radiation, the radioactivity in precipitation, and the beta activity of particles in the air. Environmental gamma radiation is measured twice during a sampling period by taking readings with a survey meter similar to a geiger counter. When making this measurement, the probe has to be shielded with a built-in stainless steel cylinder so only the high energy gamma particles which pass through the cylinder are measured. The unit of measurement is the milliroentgen per hour.*

Precipitation is collected using a funnel of about 0.4 square meter surface area. One-half or one liter of the precipitation is completely evaporated in an aluminum dish which is flattened, sprayed with a clear plastic spray, and mailed to the central laboratory.

The beta activity of particles in the air is measured by drawing a high velocity stream of air of about 1 to 1.4 cubic meters per second through a cellulose filter for the duration of the sampling period.

* A roentgen is an amount of radiation that will produce an electrostatic unit number of ions per cubic centimeter of volume.

The air sampler was designed by the A.E.C. and built at the central laboratory. It consists of a vacuum cleaner motor with a frame for holding the filter in the air stream. Upon completion of the sampling period, the operator removes the filter, places it in a glassine envelope, and allows it to sit for about five hours to allow the decay of the daughter products of radon which have a half-life of 27 minutes.

With the probe of the survey meter unshielded and placed on the center line of the round air filter the operator makes a beta-gamma reading. Another reading is made on a beta source containing 20,000 micromicrocuries of $Sr\text{–}Y^{90}$

(Continued on Page 35)

U. S. Department of Health, Education, and Welfare

Beta activity of particles in the air is measured by drawing a high velocity air stream through a cellulose filter for a measured sampling period. Five hours after the period a preliminary estimate of radiation is made. A form with this data is then submitted by the operator along with the filters to the central laboratory where a more accurate radiation count is made.

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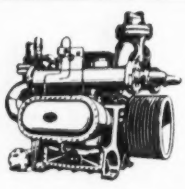

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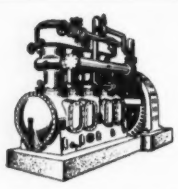

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Tuesday, April 14

The Plaza Hotel, New York City

Reception — 6:00 p.m.

Dinner — 7:00 p.m.

Speakers:

J. Carlton Ward, Jr.,
President,
Vitro Corporation of America

William Littlewood,
Vice President, Engineering,
American Airlines

F. W. Scheidenhelm,
Consulting Engineer

W. T. Alexander,
Dean of Engineering,
Northeastern University

Master of Ceremonies:
Charles A. Norris

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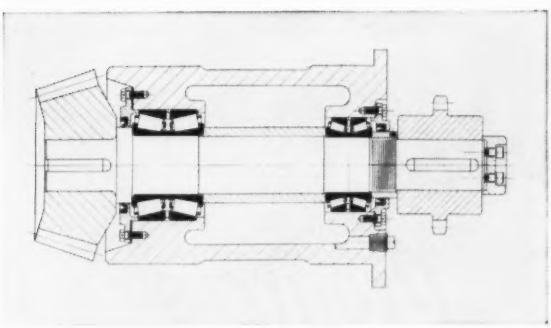

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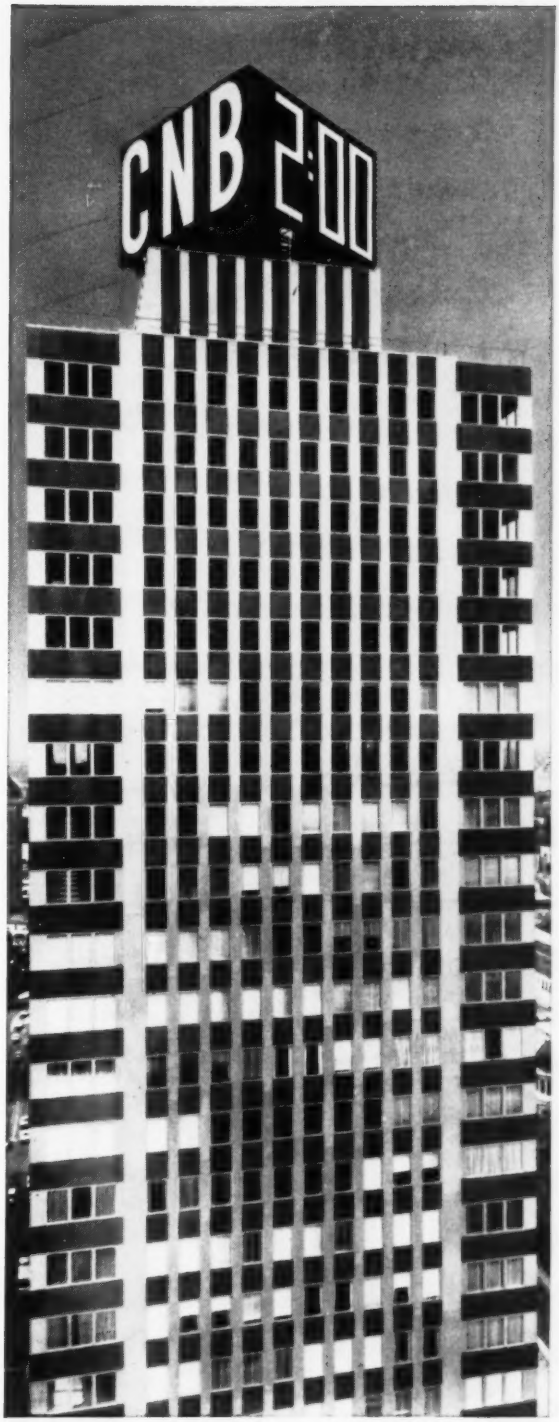

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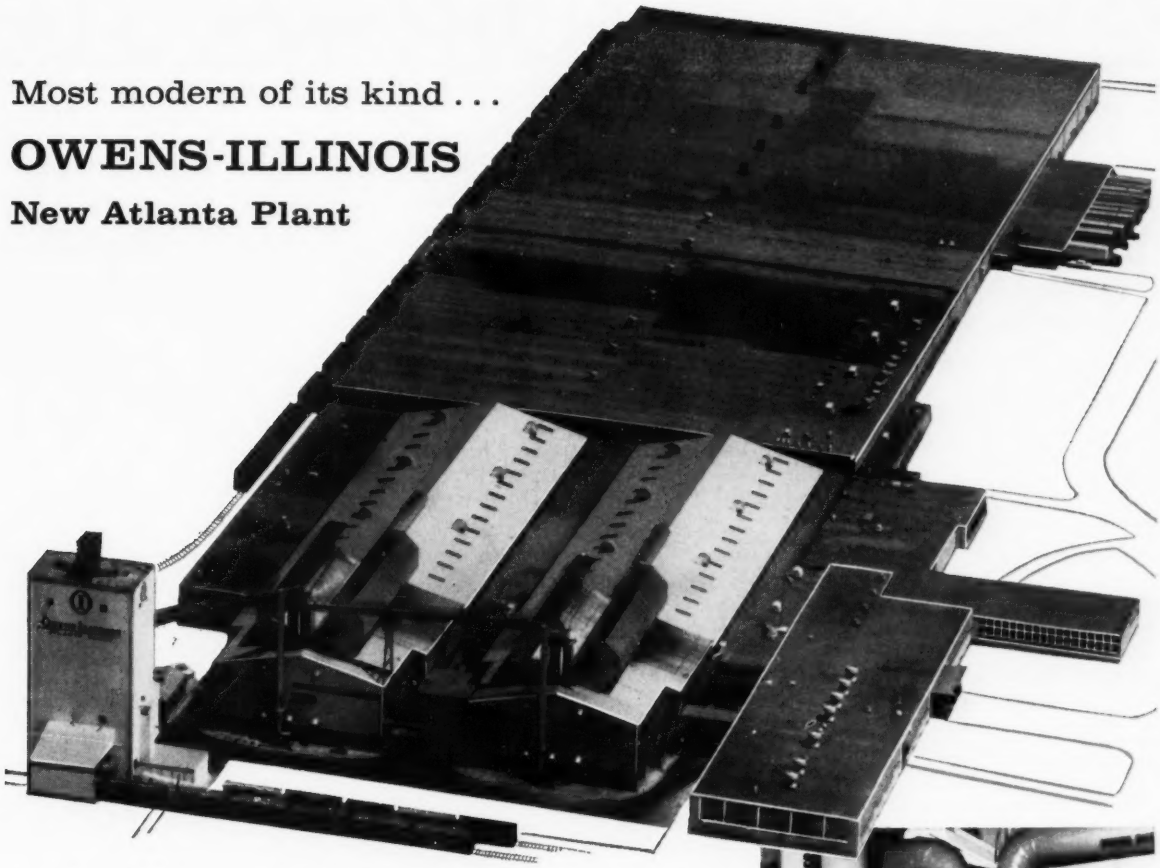

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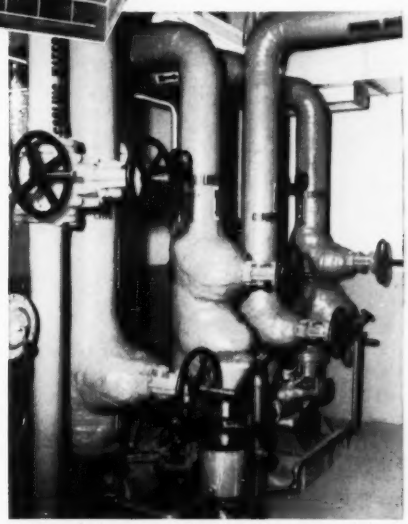

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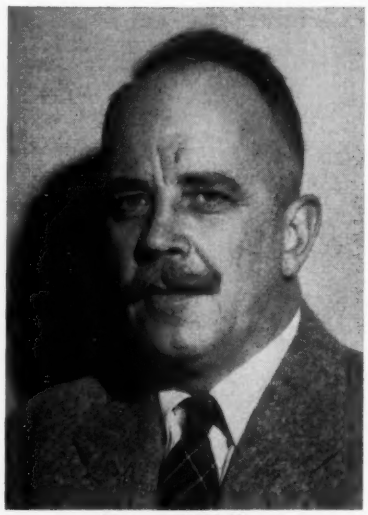


Roscoe H. Fuller

THE PRESIDENT'S LETTER—

As this is written, the date of the recognition dinner for Dean Hollister is drawing close. Early returns indicate that there will be an attendance of several hundred gathered to do honor to this great man. Holly has a host of friends within and without the University, distributed liberally among practicing engineers, educators, government officials and industrialists. I say "friends" advisedly, for to come into contact with this man is to be his friend. Others in this magazine have dwelt upon his accomplishments, which are many. What may be even more important is the personal esteem in which he is universally held.

No effort has been too great for this outstanding citizen to expend on behalf of his Country or his Profession. Withal, his demanding duties as Dean have been exercised with diligence, imagination and spirit, to the everlasting glory of Cornell and its Engineering College. Not often is it given to one man to achieve so much in the short span of twenty-two years, and rarely does a college find itself so fortunate as to have such a man at its head.

"Chick" Norris '24, famed entertainer at many an alumni gathering, was Master of Ceremonies at the recognition dinner, introducing in turn several well-known men who described the activities of our retiring Dean in different fields. J. Carlton Ward Jr., Chairman of the Engineering College Council, President of Vitro Corporation of America and a former Trustee, spoke for the University; William Littlewood, also a Trustee of the University and Vice-President of American Airlines, spoke for Industry; Colonel Frank W. Scheidenhelm, prominent consulting engineer, spoke for the Government; and W. T. Alexander, President of the American Society for Engineering Education and Dean of Engineering at Northeastern University, spoke on behalf of the Professional Societies.

Following the speeches it was my pleasant duty to inform Dean Hollister that he had been made an Honorary Life Member of the Cornell Society of Engineers in recognition of his services to the College, and in your behalf to present him a silver coffee service as a token of our gratitude and esteem. The tray bears the following words:

Presented to
SOLOMON CADY HOLLISTER
Beloved Dean of the College of Engineering
Scholar, Educator, Administrator
and
Distinguished Cornellian
by the
CORNELL SOCIETY OF ENGINEERS
on behalf of
The Alumni of Cornell University
April 14, 1959

Your Society is honored to have had the privilege of sponsoring this affair. We feel sure we echo the sentiments of every engineering alumnus when we express the hope that Cornell and its alumni will find a way to retain Dean Hollister's services in a capacity where his advice will be felt. We cannot afford to lose such a man. Cornell University still needs him.

ROSCOE H. FULLER

ALUMNI ENGINEERS

Edited by
J. F. Thomas, ME '63

Arthur J. Hughes, B.S.A.E. '48, of Wilbraham, Mass., has been appointed as instructor in the department of mechanical engineering technology at Wentworth Institute in Boston. After his graduation in administration engineering, Mr. Hughes returned for graduate work in industrial engineering and education during 1951–1953. He was previously employed by Titeflex, as plant engineer.

Warner D. Orvis, M.E. '07, was recently presented an anniversary tray marking his forty-five years of service as a trustee of Manhattan Savings Bank by the president of the bank. He is senior partner in Orvis Bros., brokers, New York City.

Joseph Pursglove Jr., C.E. '30, vice-president of research and development of Consolidation Coal Co., has been elected a member of the Board of Trustees of St. Joseph Lead Co., New York. In addition to responsibilities as head of the largest research program ever undertaken by a single coal company, Mr. Pursglove serves as president of Pitt-Consol Chemical Co. and Mountaineer Carbon Co. The former is a subsidiary of Consolidation Coal, and the latter is jointly owned by Consolidation and The Standard Oil Co. (Ohio). Mr. Pursglove has been actively associated with the coal industry since his graduation from Cornell. He is a director of Atomic Power Development Associates of Detroit, and of Bituminous Coal Research, Inc.

Joseph Pursglove, Jr.

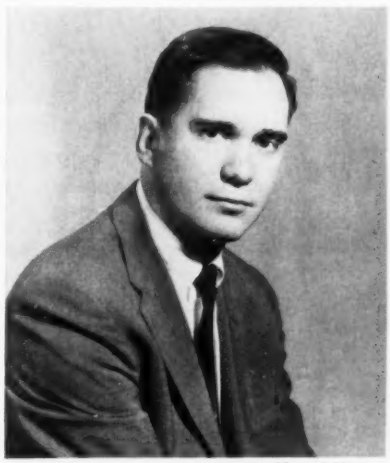
Robert T. Adams, Arts '36, a research engineer at ITT Laboratories, a division of International Telephone and Telegraph Corp., recently received an award in recognition of his co-authorship of a technical paper which was published in June. It outlines principles related to over-the-horizon microwave radio communication, a technique advanced by the ITT Labs and now in operation over a 185-mile TV telephone link between Florida and Cuba. Mr. Adams joined the ITT system in 1945, after working with Western Electric Co., and currently holds the title of senior scientist at ITT Laboratories. He holds five patents, with eleven pending.

Alumni News

Robert T. Adams

Charles A. Pfretzchner, M.E. '52 has joined the technical staff of The Thompson-Ramo-Wooldridge Products Company. He was formerly with Union Carbide Chemicals Company as an instrument engineer in process control engineering, and as a project engineer.

Jack Dorrance, M.E. '52, recently joined SI Handling Systems, Inc., Easton, Pa., as vice-president, after having been with Lamson Corp. for several years in the design, application, and sales of materials handling equipment and systems. Mr. Dorrance's new responsibilities include the engineering design, development, and application of SI's products into materials handling systems used in manufacturing, freight handling, and warehousing operations throughout the country.



Alumni News

Jack Dorrance

William C. Johnson, Ch.E. '54, has recently been transferred from the Physical Research Laboratory of the Midland Division of the Dow Chemiual Company to the Process Development Section of the James River Division. Currently involved in pilot plant operations, primarily on Zefran fiber, Mr. Johnson has been with Dow since 1954.

Earle A. Ryder, M.E. '11, retired consulting engineer for Pratt and Whitney Aircraft, has been presented the 1958 National Award of the American Society of Lubrication Engineers. The award is the highest individual award of the Society, and is presented in recognition of outstanding contribution to the field of lubrication engineering. Also, last winter, Mr. Ryder was given a thirty-five-year membership plaque by the Society of Automotive Engineers.

(Continued on Page 46)

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"Sulfonation and Sulfation"..... *Industrial and Engineering Chemistry*

"Epoxide Yield Factors in Epoxidation Reactions".... *Journal of the American Oil Chemists' Society*

"Description of New Process for Uranium Hexafluoride" Section of Atomic Energy Commission book on uranium technology

"Isocyanate Resins" ..... *Modern Plastics Encyclopedia*

"Greek Position Indicators in Organic Chemical Nomenclature".... Nomenclature Symposium, American Chemical Society Annual Meeting

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"New Uses for Hydrogen Peroxide"..... *The Journal of Commerce*

"Analytical Chemistry of Chromium"..... Treatise on Analytical Chemistry

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"Injection Molding Nylon 6" *Modern Plastics Encyclopedia*

"Amino Resins" .....*Modern Plastics Encyclopedia*

"The Removal of Some Volatile Impurities from Uranium Hexafluoride"..... American Chemical Society

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HOLLISTER . . . EDUCATOR

(Continued from Page 19)

"I call attention to the power of attack that is derived from the strengthening of that part of the engineering curricula which deals with the engineering sciences and which consists also of a wider knowledge of physics and chemistry and the use of more advanced methods in mathematics. The further strengthening of the curricula will come when these advances are continued into the subjects which follow in the curricula."

In the same paper he emphasized, however, that:

"The function of the engineer is to engineer something into existence. This may be done not only through analysis and synthesis using analytical tools, but it may also be done by trial and error or with the use of models and analogs. The work of the engineer is sharply separated from the work of the scientist, who is seeking laws of behavior and who has reached his goal when he has determined such laws within the prescribed conditions."

Defends Values of Technology

His view of education has not been limited to engineering. He has been an outspoken proponent of the expansion of opportunities for non-technical studies for engineers. However, he has defended with equal force the inherent intellectual and cultural values of scientific and technological studies. On one occasion he observed:

"Man must be concerned with his environment as much as with his behavior in human activities. After all, he has to live in his environment. A knowledge of the environment and its adjustment to the needs of man is the business of science and technology. A liberally educated man must have some basic knowledge concerning the environment, and must understand the extent of achievement of human thought in this direction. This is as important to him as a study of the achievement of man in controlling individual and collective behaviors and in the development of thought processes."

It is understandable that from this same viewpoint he has strongly encouraged the study of the history of science and its influences upon man's progress. He has supported the program in this area at Cornell, and has pursued a personal interest by gathering a notable collection of early scientific and engineering works.

A review of Dean Hollister's influence on engineering education in this form is necessarily fragmentary and kaleidoscopic. His influence on the profession as a whole is still another dimension, ranging from his own achievements as a designer, consultant, and researcher to his services to the nation on such agencies as the Second Hoover Commission, the Signal Corps Development and Research Council, and the chairmanship of the Board of Consultants for Isthmian Canal Studies.

To Cornellians, he leaves on retirement the heritage of a College occupying, for this new era, the pre-eminent position among educational institutions it had first won under the early great Cornell leaders. Twenty-two years ago he accepted a job and a challenge at a decisive juncture in the history of the College. It is now apparent that a less vigorous, a less stimulating, a less persuasive personality could not have matched the progress of the College against the accelerating development of the times. Dean Hollister has accomplished not only this, but has seen Cornell Engineering take a place where it is itself, through its faculty and students, contributing generously to the break-through on many frontiers of technology.

The symbol of his tenure at Cornell will always be the new Engineering Quadrangle. Dean Hollister will emphasize that this stands for many things—the proper extension into the present and the future of Cornell's traditional stature in engineering, and the will of the alumni and the University to make secure this stature; the vitality of a faculty which generates from buildings and laboratories and machines the spirit of learning and seeking; the inherent strength of privately-supported institutions —and to be sure these are all part of an accomplishment of this kind. But these elements could not have been brought together to form the physical reality of an entirely new College development without the dreaming, and believing, and doing of a Solomon Cady Hollister.

The fact that this review of Dean Hollister as an educator does not cover in detail the story of the new development of the College is in no way intended to minimize the achievement of this goal. It is the foundation from which it has been possible to build the educational structure that is Cornell Engineering today. But it is a full and exciting story in itself, too large for appropriate treatment here.

In an address to prospective engineers, Dean Hollister once said:

"And last of all, dream. Dream the ideal. Dream the beautiful. For through dreams progress springs eternal."

He has been that fortunate man who has dreamed, and lived his dreams.

BERYLLIUM

(Continued from Page 24)

metal producers, and the beryllium dust problem was of major concern to the fabricators of metal parts. Recently, however, through improved safety precautions, the toxicity problem has been overcome. Today this problem is of little significance to the consumer.

Beryllium has achieved great strategic and industrial importance as an alloy metal, especially as a copper alloy. Largely through expanded fields for the beryllium-copper alloy, the industry has grown at a fairly rapid rate. Two wars have aided this growth.

Right now the beryllium industry is on the threshold of a large expansion through increased utilization of the metal. The most immediate potential use of beryllium metal is in the aircraft industry. If, and when nuclear power becomes important, demands for beryllium, both metal and oxide, will soar. In lieu of these possible fields for beryllium, the future looks bright. However, two major factors dim the picture considerably.

Sources of beryl are limited, and the metal, when it is found, is generally realized in very low grade deposits. Most of the significant deposits are in South America or Africa. There is no foreseeable end to our dependence on these sources, because the United States reserves are small and of low grade.

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HOLLISTER . . . PALEONTOLOGIST

(Continued from Page 20)

ties on molluscan problems. They led him to dissecting snails' teeth, to photographing their characters, and to seeking notes, pictures, and details of names and specimens from Europe. The culmination of the story of the man who bought a book is that that man himself wrote a book on shells—the initial part of a planned series of three, called, *A Review of the Genus 'Busycon' and its Allies—Part I.*[*]

Although the *Busycon* is one of the most common and largest of sea shells found along the Atlantic and Gulf Coasts, its name and character is involved in a dilemma of facts.

Without prejudice or preconceived ideas, Dean Hollister attacked the problems with his typical forthright reasoning and marshalling of facts. The result is a thorough work of high standard based on extensive collection of data and specimens. His shell collecting has gone beyond that of the amateur, his book beyond the area of just another scientific paper. It will stand as a basic treatise in the field of conchological literature.

For Part II of his shell theme, already large suites of fossil Busycons or whelks have been gleaned from beach and storehouse. That part will analyze and tell the story of the ancestors of the living shells along the ancient continental shores. Part II will lead to Part III, in which the soft tissues of the creatures will be dissected and the anatomy will be described. Some of such investigation may reveal new relationships or prove or disprove ones now postulated. That parts II and III will lead to further dissertations may be surmised for it may be assumed that the subject of the whelks will be thoroughly explored before the author places his Q.E.D. on this problem of shell life.

An ideal hobby is one which is combined with recreation and investigation, and which makes a contribution to knowledge. S. C. Hollister, the engineer, has thus channelled his hobby to mark such a pattern.

[*] Paleontographica Americana, vol. IV, No. 28, 76 pp., 11 pls., 1958, Pal. Res. Inst., Ithaca, N.Y.

RADIOACTIVE FALLOUT

(Continued from Page 25)

beta activity. A curie is a quantity of a radioactive isotope undergoing 3.7×10^{10} disintegrations per second. By direct comparison of the two readings the operator can estimate the gamma-beta activity in the filter. This procedure is necessary for the operator to get an early estimate of air radioactivity. The filter is then mailed to the central laboratory along with the precipitation sample.

The sampling period is usually twenty-four hours long. However, during periods of high activity levels this may be shortened to four hours. During non-testing periods the stations are put on a "⅓ duty cycle." This means that the air samplers are connected to a timer switch which allows them to be in operation only one out of every three hours. During this period only two samples are made each week. With the samples the operator submits a form on which he has written his readings. He also sends copies to the State Health Officer and to the Public Health Service office in his region. If the samples show ten times the normal activity the Division of Radiological Health is notified by telephone.

More Accurate Analysis Made

At the central laboratory the forms submitted with the samples serve as data sheets for more accurate analysis using the equipment of the laboratory. The precipitation samples and the air samples are both tested the same way using a Nuclear Measurements Corporation gas flow proportional counter. The samples are put one at a time into a drawer in the counter which when closed forms a chamber. At the top of the chamber is a seven and one-half inch diameter aluminum foil window. A 10 per cent methane, 90 per cent argon gas mixture fills the chamber as counting gas. Beta particles from the samples penetrate the aluminum foil and ionize the gas while alpha particles are kept out by the thickness of the foil.

Connected to the counter is a Nuclear-Chicago Ultrascalar which is basically a sensitive amplifier to count the ionizations. The ultrascalar has a 100 millivolt input sensitivity and can count up to 800,000 random pulses per minute.

The air samples are counted for one minute and the water samples are counted for five minutes after which the average background count is subtracted from the final count. The average background is determined by measuring the time it takes for 10,000 counts to register with no sample in the chamber. The sample count after subtraction is compared with a standard count derived by measuring the time for 100,000 counts to register with a 20,000 micromicrocurie beta source in the chamber.

The samples are first counted in the laboratory at least three days after the end of collection to avoid interference by natural thoron daughter beta radioactivity which has a half-life of 10.6 hours. Seven days later the samples are counted again. The total from the second count which is smaller because of decay is plotted with the first total on a hyperbolic curve graph. The approximate age of the particles in days at the end of collection can be determined from the rate of decay plotted on the graph.

The approximate age, along with the calculated micromicrocuries per cubic meter of air from the air samples and the micromicrocuries per liter and per square meter of surface area from the precipitation samples, is noted on the data sheets. These sheets are filed in the laboratory and every four weeks a tabulation is made. This is distributed to the Atomic Energy Commission, State and Territorial health departments, and all other interested agencies.

Aside from day to day watching of the amount of radiation around us the network provides useful information to the weather bureau and other interested parties about the paths traveled by atomic particles in the atmosphere. In addition, accumulated reports provide material in future years for study of the effect which radiation has had on the human race.

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COLLEGE NEWS

Edited by A. Speare, Jr., EP '63

BOOKER, ERICKSON NAMED NEW DIRECTORS OF EE SCHOOL

Professor Henry G. Booker, one of the world's foremost authorities on the propagation of electric waves, has been appointed director of the School of Electrical Engineering. In addition, William H. Erickson, professor of Electrical Engineering at Cornell since 1945, has been named assistant director of the School.

Professor Booker began teaching at Cornell in 1948. Prior to that time he was a lecturer in theoretical physics and mathematics at the University of Cambridge. From 1940 to 1945 he was the principal scientific officer and leader of the theoretical group at the Telecommunications Research Establishment of the Ministry of Aircraft Production at Malvern, England. He received his B.A. and Ph.D. degrees from Cambridge University in 1933 and 1936, respectively.

In 1954–55 Professor Booker returned to England as a Guggenheim fellow and conducted research on the physics of the outer atmosphere. In addition to writing a number of scientific papers, he has recently written a textbook, *An Approach to Electrical Science*, which is scheduled for publication by McGraw-Hill this month.

Professor Booker, who has been a member of the International Geophysical Year committee of the National Academy of Sciences, holds the position of chairman of the Institute of the Radio Engineers Advisory Committee of the Bureau of Standards and is a member of the General Science Panel headed by the Secretary of Defense.

Professor Erickson received his B.S. degree in electrical engineering from the University of Pittsburgh in 1938 and his M.S. degree in electrical engineering from Carnegie Institute of Technology in 1946. From 1942 to 1945 he was an instructor at the Naval Training School.

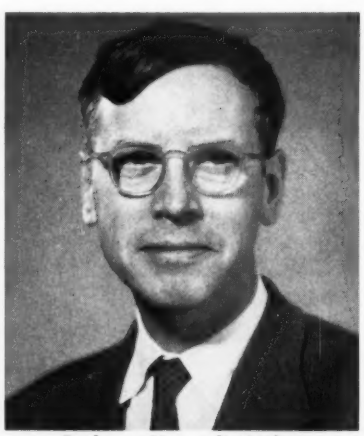
Prof. Erickson is the co-author of *Electrical Engineering, Theory and Practice* with Nelson H. Bryant of the School of Electrical Engineering. Professor Erickson is also a member of the American Society for Engineering Education, Eta Kappa Nu, Tau Beta Pi, and Sigma Tau.

ME SCHOOL PLANS INDUSTRIAL ENGINEERING SEMINAR

The Department of Industrial and Engineering Administration of the Sibley School of Mechanical Engineering will sponsor its sixth annual Cornell University Engineering Seminar this summer. The seminar, which will run from Tuesday, June 16, to Friday, June 19, will bring about 150 engineering and management personnel to the campus from industries all over the nation. Its purpose will be to offer a reappraisal of today's industrial problems and a consideration of their remedies.

The seminar has been planned around eight distinct groups each of which will feature topics of current and vital interest to industry. Each of these groups will hold eleven sessions during the week at which speakers will talk on the various topics. The seminar groups will include Industrial Management, Manufacturing Engineering, Small Plant Management, Methods and Work Measurement, Applied Industrial and Engineering Statistics, and Statistical Aspects of Component Reliability.

Besides these, two new seminar groups have been added this year. The first of these is Engineering Administration which has been added in view of the growing concern over problems of utilization and control of engineering resources. Discussions in this area will cover such topics as estimating engineering work time, improvement of engineering work methods and procedures, non-financial incentives, and morale. The second group, Computers in Production Planning, has been added in order to stress the use of electronic computers to assist planning and scheduling of production and to help control inventories.



Professor Henry G. Booker

Along with the meetings of the eight different seminar groups there will be several combined sessions. These will include a lecture by James P. Stewart '28 who is president of DeLaval Steam Turbine Company, a welcome and address by Frederic C. Wood of Wood and Sibbert, Consulting Engineers, and a lecture by David Hertz from Arthur Anderson Co. There will also be a lecture by Alfred E. Kahn, chairman of the department of economics at Cornell, on the subject "Economic Outlook, Long and Short Term" and a lecture by Dr. Harry J. Johnson, director of the Life Extension Foundation, on the topic, "So You're All Tensed Up."

Besides the combined lectures, there will be a group banquet at which William Bynum, president of Carrier Corp., will speak on the topic, "Reacting to Change." There will also be a barbecue at the Moakley House and a smoker.

COMPANY OFFERS PRIZE FOR BEST BUILDING DESIGN

This year Cornell undergraduates, especially civil and mechanical engineers, have the opportunity to participate in a contest sponsored by the Wallace Steel Company of Ithaca for the design of a new steel fabricating building.

A prize of between $750 and $1250 is being offered for the best design, which will be chosen on the basis of originality, economy of function, economy of first cost, and completeness and neatness in presentation. The deadline for entries is June 10, 1959, and the announcement of the winner will be made

on June 13. The judges will be Marvin J. Freedman of the Wallace Steel Company, J. F. McManus, assistant dean of the College of Engineering, and a professor of the Civil Engineering School to be chosen by Director N. A. Christenson.

In one of the structural design courses, some of the students are using this contest as a project. Two entries have already been received with about four more expected before the deadline.

ASPHALT TECHNOLOGY SUMMER PROGRAM TO BE OFFERED

The Civil Engineering School will join with The Asphalt Institute in co-sponsoring a six-week summer graduate program for college engineering instructors interested in asphalt paving technology and construction.

The program, which consists of six units of graduate courses and a series of seminars and field trips, will offer courses in bituminous materials, design and analysis of highway and airport flexible pavements, and other special subjects.

Under the direction of Professor Taylor D. Lewis, head of the department of transportation engineering, the program will begin June 16, 1959, and will be the first to use Hollister Hall, the new civil engineering building.

CIVIL ENGINEERS HOLD ANNUAL CONVENTION

Professor George Winter, head of the structural engineering department of the School of Civil Engineering recently gave the opening speech at the Structural Division of the annual convention of the American Society of Civil Engineers in Los Angeles.

Civil Engineering School Director N. A. Christensen serving as program chairman on the executive committee of the irrigation drainage division helped plan programs for the conventions of the next two years.

Dr. Bengt Broms, who will begin employment with the School of Civil Engineering as an associate professor this summer, also attended the soil mechanics division of the convention.

SYMPOSIUM ON NUCLEAR WEAPONS POLICY HELD

In a symposium sponsored by the Student Committee on Sane Nuclear Policy, Professor Jay C. Orear of the physics department stated that the world is fast approaching a nuclear danger point, beyond which its existence will become extremely unstable. This point will be reached when nuclear arms become so plentiful that small nations and political groups can possess them. Then, according to Professor Orear, any small conflagration could easily spread into an all-out nuclear war. He stated that it would now be possible for a city to be bombed through the use of a nuclear "suitcase bomb" which could be carried into the city and set to go off. Orear emphasized that it is therefore necessary to halt the arms race to prevent the entrance of nuclear weapons into the hands of irresponsible groups.

If a ban on nuclear testing is to be instituted, a workable means of detecting nuclear explosions will have to be devised in order to prevent "cheating." If a nuclear test ban were agreed upon, it would be unlikely that any surface or air explosions would be attempted since they cause considerable radioactive fallout and are easily detectable. Underground explosions are, according to Orear, much more difficult to detect. It is for that reason that the detector system now under consideration entails the setting up of seismographic stations.

Orear stated that the new "first motion" method of detecting underground explosions has proved fairly effective in differentiating nuclear explosions from earthquakes. Professor Orear explained that the seismographic stations first sense the direction of the first movement following a disturbance. If the disturbance is a nuclear blast, the initial movement as sensed from any point is always away from the blast. On the other hand, if the disturbance should happen to be an ordinary earthquake, roughly half of the seismographs would indicate movement toward the source. Thus, Orear continued, with a sufficient number of stations, the nature and location of a disturbance could be determined with some accuracy. Inspection teams could be sent to examine the area suspected of receiving the blast.

Explosions of bombs over one kiloton in size could be detected with some accuracy by this method. The testing of bombs smaller than that would, according to Professor Philip Morrison who also took part in the panel discussion, not be likely to yield information of sufficient importance to upset the balance of technical knowledge between the United States and Russia.

Gary Klock

Professor Jay C. Orear advocated the halting of the arms race at the "Nuclear Policy" symposium.

NEW CE PROFESSOR TO DO WORK IN SOIL MECHANICS

Dr. Bengt B. Broms has been appointed an associate professor in the School of Civil Engineering in the department of soil mechanics. Dr. Broms will begin work at Cornell in July by organizing laboratory and course work in soil mechanics and setting up facilities in the new civil engineering building.

After receiving his B.C.E. degree from the Chalmers University of

Photo Science

Professor Bengt B. Broms

Technology, Gothenberg, Sweden, in 1952, Dr. Broms went for graduate study to the University of Illinois, where he received his M.S. and Ph.D. degrees. His doctorate thesis was concerned with reinforced concrete theory. Since 1956 he has been employed by the Shell Development Company in Houston, Texas, working on the difficult soil mechanics problems connected with the establishment of off-shore drilling platforms.

Dr. Broms is a member of the American Society of Civil Engineers, Sigma Xi, Tau Beta Phi, and Phi Kappa Phi.

CHEM. E. SCHOOL INSTITUTES NEW LAB COURSE IN POLYMERS

The Chemical Engineering School has started a new laboratory course in polymers this spring. The purpose of the course is to give students an opportunity to produce polymers such as plastic and rubber and to test their properties.

The polymer lab is a one credit hour course which meets once a week for three hours and is directed by Professor Roderiguez. The lab is primarily for seniors and graduate students who have taken a course in polymeric materials, although it is open to anyone who has a background in the field.

The laboratory work has been divided into four general sections. The first of these involves the production of the polymer from low molecular weight substances. The second involves the testing of fundamental properties such as molecular weight and flow characteristics. The third involves the fabrication of the polymer by molding or casting, and the last section involves testing the fabricated article for tensile, electrical, and film properties.

PROF. WEHE RECEIVES FACULTY FELLOWSHIP

Prof. Robert L. Wehe of the department of machine design in the Sibley School of Mechanical Engineering has been awarded a National Science Foundation Faculty Fellowship. Prof. Wehe will take a one year leave of absence beginning next fall and will work toward his Ph.D. in mechanical engineering. His thesis will probably be concerned with clutch and brake materials.

Prof. Wehe graduated from the University of Kansas in 1948. He taught at the University of Illinois while obtaining his master's degree until 1951. In that year he came to Cornell as an instructor in machine design.

THERMAL COLUMN BEING DESIGNED FOR REACTOR

As a part of the design work on the nuclear reactor facility which is slated for construction on the campus in the near future, experimental investigations of an improved thermal column design are being carried out in the department of engineering physics, College of Engineering. A thermal column is a large (typically four feet by four feet by six feet) block of graphite or other material which has the ability to slow down high energy neutrons. Fast neutrons enter one face of the column, and the other faces become sources of slow neutrons which are in thermal equilibrium with the nuclei of the graphite. Neutrons of these energies are useful in a wide variety of scientific investigations, especially in the field of reactor physics.

ALUMINUM COMPANY GIVES EQUIPMENT TO CORNELL

The College of Engineering has recently received a sizable gift of surplus equipment from the Aluminum Company of America through its college relations program. The equipment consists mainly of recording and controlling apparatus which can be used in the laboratories of the various engineering schools.

W. C. White, who graduated from the Cornell Civil Engineering School in 1917 and is now president of Alcoa's Steamship division, assisted in obtaining the equipment.

AERO LAB HELPS DEVELOP AIR TRAFFIC CONTROL SYSTEM

Cornell Aeronautical Laboratory has recently aided in the development of an experimental system of air traffic control for Navy carriers that uses an electronic computer to direct aircraft onto the carriers. The new system will make it easier for aircraft to land safely and quickly on Navy carriers under any weather conditions.

Cornell Aeronautical Laboratory serves as technical advisor to the Navy on the entire program and has the responsibility for the development of the "local" air traffic control system which guides aircraft from a few miles away from the carrier to the point where the automatic landing system takes over.

The control system, which is built around a high-speed digital computer, transmits commands for speed, heading, and altitude to the individual aircraft every few seconds in order to keep the planes moving toward the carrier in a continuous line.

This new system has several advantages over the present "stack up" procedure that requires aircraft to maintain given altitudes at thousand foot intervals over the carrier. The new system is much easier to follow when the aircraft is short on fuel after a mission or in bad weather.

Aircraft that are waved off from landing because of a faulty approach are quickly fitted back into the stream by the control system.

Cornell Aeronautical Laboratory is currently testing this system at the Buffalo Airport.

HOLLISTER . . . ENGINEER

(Continued from Page 21)

Wright research and development laboratory in Buffalo into what we know today as the Cornell Aeronautical Laboratory, one of this country's great research and development centers in the development of weapons and weapons systems for the national defense. The problems of converting a commercial laboratory into a university facility, with accent on scholarship and research and with all of the financial and organizational problems involved, were met by him with the courage and persistence which have been outstanding characteristics of all that he has done.

Brings Airport, GE, to Ithaca

Similarly, he recognized the need of a modern airport for the University and played the leading role in developing the present airport. This was followed by the Advanced Laboratory for Electronics of the General Electric Company, now to be further enlarged. It is a useful adjunct to the University as a field for advance work of interest to the professors and as a means

of having available to the Engineering College distinguished engineering scientists.

It can truthfully be said that no project, no matter how difficult, failed to attract his support wherever it could be shown to strengthen the Engineering College and the work of Cornell University. When Dean Hollister expresses his views on engineering education, developed from his rich professional service and his extensive reading in history and philosophy, we see the breadth of his understanding and the high goal that he has set for it. Here lies the secret of his pioneering the new curricula at Cornell and the objectives of the five-year engineering course discipline.

Most important is the entire concept of the new Engineering College which he began to develop in the early depression 1930's and which, by undaunted courage and persistence has resulted in the extraordinary plant that has come into being at Cornell today. His sponsorship of the new atomic facility with its accent on undergraduate teaching, reflects his philosophy that the engineer educated today must be prepared for the problems two decades hence, when he will be at the peak of his professional development.

In another direction, his working as a member of the Second Hoover Commission for the reorganization of our government has been outstanding. Herbert Hoover leaned on him heavily. Of the many findings and reports issued from this high level body, Dean Hollister is the editor and author of many, covering a wide spectrum of problems for our national government.

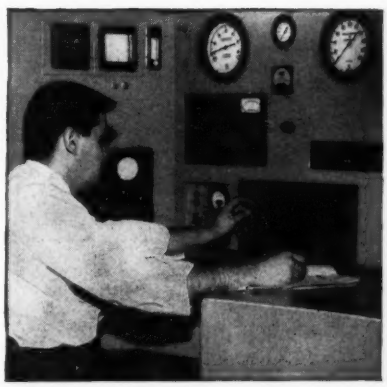
Awarded Lamme Medal

Dean Hollister has played an important role in the professional societies which are so important to the engineering profession. He has fulfilled policy and Committee assignments without number. After serving as President of the American Society for Engineering Education, he was awarded the Lamme Medal by the Society.

His work on the Engineers Joint Council has had an ever-widening influence and done much to shape the thinking in sister institutions as well as at Cornell. His speeches before industrial groups and meetings have ever pointed out the new horizons and professional needs within these industries to be met by a new generation of engineers. He has continuously stressed the need for upgrading the professional, economic, and social status of the engineer to meet the needs of a growing society. He has stressed that there is not an inexhaustible supply of manpower available to fill any engineering shortage; actually only a very small percentage of those available have the capabilities and determination to become an engineer. Engineers, therefore, must be better utilized in their professional work in a manner similar to the professional organization of doctors and dentists, where the professional man is assisted by a trained team of aides.

As one who has had occasion to work with Dean Hollister in the various engineering disciplines, it has never ceased to astonish me that his perception of the future for these diverse disciplines reflects new areas of professional needs even before they have become apparent to many who are actively working in these professional areas throughout industry.

To attempt to portray the career of Dean Hollister is, in itself, a frustrating endeavor. His lifetime activities have been so widespread and diverse that they can be said to portray an individual whose knowledge has few, if any limitations other than those of time and his own choice. He is a scholar, yet one with a practical understanding of the world that lies outside of scholarship. He has worked with distinction in a variety of industries, both directly and as consultant. He has exerted great influence in the teaching profession as well as the accomplishment of a forward looking and unusual pattern of engineering education at Cornell. His influence is often sought and widely effective in many facets of our government, and yet with all this, he is a most human man whose friendship is warm and whose personality is such that it stimulates in others their desire to give of their own best talents.



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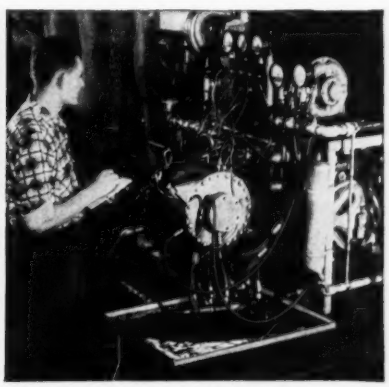

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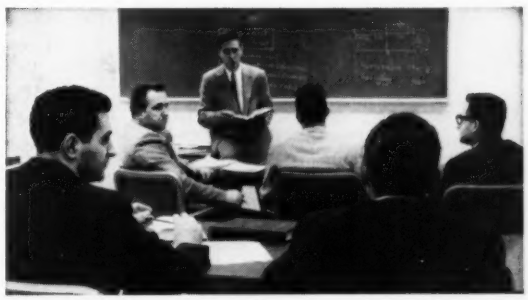

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TECHNIBRIEFS

Edited by R. H. Robinson, ME '63

SMALL FURNACE INSURES STEADY TEMPERATURE CONDITIONS

The National Bureau of Standards is making use of an unusual type of furnace which readily provides steady temperature conditions between selected temperature limits. Simply constructed to any desired size, this furnace appears applicable to most processes that require a temperature gradient.

The furnace was designed for use in preparing thin metal films of different average-crystalline size, which are used to study electron scattering. As these films are deposited by vacuum evaporation on rock salt crystals heated to various temperatures, a compact, simple furnace was needed. The resulting device is being considered for measurements of the thermoconductivity of metals at very high temperatures as part of the Bureau's building technology program.

The furnace consists essentially of three tantalum strips, spot-welded together in the form of an "H." Thermocouples for temperature measurements are placed at various points along the crosspiece between the legs of the "H," which are heated by separate transformers. The heating current for this arrangement will maintain either end of the crossbar at any selected temperature between room temperature and 900 degrees Centigrade.

The size of the furnace can be modified to fit any particular application, and temperature limits can be extended in both directions. Tantalum will withstand temperatures from the liquid nitrogen range up to 2000 degrees Centigrade.

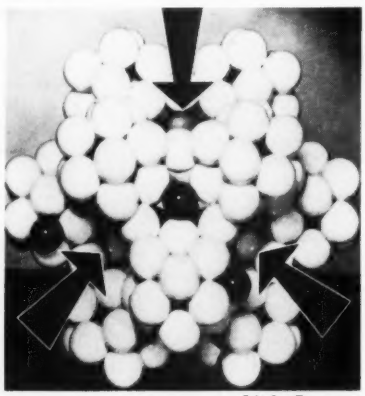
Hour tests at temperature differences as great as 500 degrees Centigrade have shown that temperature remains constant to one degree. Such steady temperature conditions are rapidly attained because the furnace has a small mass compared to the available electrical power and out-gassing from components is negligible. Although the temperature distribution is not linear, this causes no difficulties, for the temperature can be directly measured at any point along the bar.

ADSORBENTS AID RAPID CURING OF RUBBER AND PLASTICS

A new class of adsorbents called Molecular Sieves used to obtain faster and more efficient curing systems in rubber and plastics has been developed by Linde Company, Division of Union Carbide Corporation.

Molecular Sieves are man-made crystalline materials which are chemically similar to many natural clays and belong to a class of minerals known as zeolites. The outstanding characteristic of these materials is their ability to undergo dehydration with little or no change in their crystal structure. The dehydrated crystals are interlaced with regularly spaced channels of molecular dimensions occupying 50 per cent of their volume.

After dehydration, the empty cavities in activated Molecular Sieve crystals have a strong tendency to recapture the water molecules that have been driven off. This tendency is so strong that if no water is available they will accept any molecules that are small enough to pass through the pores of the crystal. Molecular Sieves have a high affinity for polar molecules and will adsorb them in preference to non-polar compounds. The materials used in the rapid curing of rubber and resins are usually very polar.



Linde Company

A model of a Molecular Sieve crystal unit illustrates how the arrangement of atoms forms several pores opening into a single cavity and through which the adsorbent forces act.

Therefore, the active compounds are adsorbed on the interior surface of the crystal and are thus isolated from the rubber or resin formulation during the processing and storage steps. However, at curing temperatures, which are generally higher than processing temperatures, the active compound is released from the Molecular Sieve to accelerate the curing reaction. This operation permits the use of highly active compounds to obtain fast cures without sacrificing processing safety.

Chemical-loaded Molecular Sieves can be used as latent accelerators and curing agents in a variety of rubber and plastic formulations. Processors are investigating their use in such items as tires, mechanical goods, hose, belting, and footwear.

ULTRASONIC SEAM WELDER MAKES DISSIMILAR METALS WELDABLE

An ultrasonic seam welder that can weld sheets of dissimilar metals continuously has been developed by the Westinghouse Electric Corporation. This welder brings to seam welding the advantages of ultrasonic welding. It makes dissimilar metals weldable and eliminates the need for surface preparation prior to welding.

Before development of this welder, the only available method for joining dissimilar metals was cold welding, which had the serious disadvantage of requiring a large deformation of the metal pieces being joined. Ultrasonic welding makes these large deformations unnecessary.

During the welding process, sheets of metal to be welded are passed between two wheels vibrating at 20 kilocycles per second. The surfaces of these wheels press against the metals on opposite sides of the sheets. At the point of contact, the wheels break up the oxide coating on the metal surfaces and by a kneading action weld the metal lattices on the surfaces of the

metals themselves. No electric current is passed through the spot being welded, although in appearance the ultrasonic seam weld is similar to that of an electric weld. A variable speed drive moves the metals through the unit as the weld is completed.

The center of the vibrating wheel is attached to a transducer assembly which is used to convert electrical energy to the high-frequency mechanical vibrations. In operation, electrical power causes the transducer to vibrate longitudinally. The vibration is passed down a coupling bar and enters the wheel causing the center to be pulled in and out. This motion creates vibrations which move radially out to the wheel's circumference. The wheel surfaces in contact with the work move in opposite directions by having the transducers work in opposition to each other.

WALL PANEL LIGHTS ROOM AND REGULATES TEMPERATURE

A full-scale wall panel that promises to light tomorrow's home while also heating or cooling it has been unveiled by Westinghouse Electric Corporation. The panel responds to a set of dials which can change its temperature from a low of 55 to a high of 120 degrees Fahrenheit, and vary the intensity and color range of the light source.

Controls for the entire panel consist of four dials: one to change color combinations; a second to vary the light intensity; a third to select either heating or cooling; and a thermostat for automatic temperature control. A living room could be illuminated with a white or golden light during the day, and then by converting to soft blue tones the same room could be transformed into a totally different mood for the evening.

The hot-cold-light panel is made possible by combining thermoelectric heating and cooling and electroluminescent lighting. The thermoelectric effect is accomplished without the aid of any moving parts such as those present in conventional refrigeration. Thermoelectric refrigeration produces cooling in special solid materials directly from the flow of an electric current. Heating occurs when the direction of current is reversed.

Electroluminescent lighting is produced by exciting a phosphor coating with an alternating current. This phosphor coating is sandwiched in a panel no thicker than a pane of window glass.

At the present time, this achievement is still in the developmental stage and no plans are being made for introducing such a panel as a commercial product. A demonstration panel has been constructed which provides a range of hues from blue to blue-green to green. According to Westinghouse engineers, other color combinations including the entire spectrum are possible.

ULTRASONIC VIBRATIONS MAKE CLEANING TASKS EASIER

Various cleaning tasks have been made easier by a new transducer recently developed by Westinghouse scientists. The transducer is twice as efficient, one-fourth as costly, and more compact than existing transducers of comparable power.

The ultrasonic transducer is a device that changes electrical energy into mechanical sound vibrations. Ultrasonic cleaning is caused by cavitation, which is the rapid formation and collapse of tiny bubbles within a liquid energized by ultrasonic vibrations. The kitchen sink of the future may be wired for sound, for Westinghouse scientists are conducting laboratory tests of the effectiveness of this unique way to help the housewife in her kitchen cleaning jobs.

The Westinghouse transducer is of a general class called "magnetostrictive." It consists essentially of a coil of wire wrapped around a core of magnetic material, such as an alloy of iron or nickel. Alternating electric current flows in the coil, setting up in it a magnetic field, first in one direction, and then in the opposite direction. The magnetic field alternately magnetizes and demagnetizes the metal core, causing it to change very slightly in length. A metal plate, bonded to the core, is vibrated back and forth

Westinghouse

Ultrasonic vibrations help to clean a soiled drinking glass. Various kitchen cleaning tasks are made easier by the development of a new and improved transducer to convert electrical pulsations more efficiently into sound waves above the range of human hearing.

a few ten-thousandths of an inch at the frequency of the alternating electrical pulsations.

Conventional transducers contain thin metal laminations built into stacks which are driven by an electric current. The stacks are spaced a few inches apart and welded to a metal plate. In this way the stack energizes the plate only at the spot to which it is attached, and the plate, driven at scattered points on its surface, vibrates in wave-like motion. These plates must be tuned exactly so that the vibrations circulating in them reinforce rather than oppose each other.

The Westinghouse transducer eliminates the idea of separate stacks of laminations scattered at intervals across the plate's surface. Instead, the laminations are spaced in a sort of latticework, and each works in unison with all the others to cause the plate to pulsate in and out with a single piston-like movement. This construction makes the plate more efficient and less expensive, since no tuning or machining of any kind is required.

In addition to kitchen cleaning tasks, transducers are used in electroplating aluminum bus bars with silver, cleaning printed circuitry boards for television and radio receivers, and decontaminating pieces of nuclear apparatus.

MYSTERIOUS OBJECTS IN THE SEA PLAGUE SONAR SYSTEMS

New discoveries concerning the unknown objects which hinder underwater signals have recently been made by Westinghouse scientists. These objects, believed to be some form of marine life, cause most of the noise that jams sonar systems.

The scatterers affect a sonar signal much as droplets of fog disperse and reflect the beam from an automobile headlight. They produce a confusing jumble of unresolved echoes that limit the range of sonar signals and interfere with their clear reception.

As radar guides aircraft, sonar acts as the eyes of a submarine. In sonar, sound waves are formed into a beam and transmitted through the water. Underwater objects distinguish themselves by reflecting the waves back to a sonar receiver. Unfortunately, sound waves are also reflected by various scatterers in the water. Therefore, in addition to the desired signal, the sonar receiver picks up a continuous distracting assortment of indistinguishable echoes called reverberation.

To learn more about the causes of reverberation, Westinghouse scientists beamed high-frequency, narrow pulses into the water, and the jumble of sonar noise broke down into separate distinct echoes. These distinct echoes proved that discreet objects in the sea were the source of reverberation.

Of the total underwater interference, 70 to 90 per cent was directly attributed to individual objects. About six times as many objects were found at 80 feet as at 380 feet, but the accoustical size of the 380-foot scatterers was about three times larger. Physically, if these scatterers were bubbles of air, they would be about the size of a pinhead. This seems too small to bother sonar detection, but the total number of objects is enormous. A square mile of ocean one-fourth mile deep must contain about one billion of them.

Through experiment, scientists found that the objects moved with speeds of up to one-tenth knot. This observation led to the conclusion that these individual scatterers are forms of animal life capable of motion. Theories as to their exact nature mention such varied creatures as fish, shrimp, squid, and a host of small organisms barely visible to the naked eye.

Plans for future investigation include spotting each scatterer electronically with high-frequency sound waves and identifying them photographically with a powerful underwater camera.

ALUMNI ENGINEERS

(Continued from Page 31)

William D. Bickel, M.E. '21, was elected a vice-president of Dravo Corporation. At the same time, he was appointed general manager of the Machinery Division.

Manager of the division's Engineering and Construction department since 1956, Mr. Bickel started with Dravo in 1936 as a sales engineer. He has held numerous other engineering and supervisory posts.

He is a member of the Engineers Society of Western Pennsylvania, the Duquesne Club, Pittsburgh Golf Club and Fox Chapel Country Club.

John E. Roth, C.E. '22, is director and senior vice-president of the Tidewater Oil Co. He started out in 1932 as a surveyor for the company.

Newton C. Farr, C.E. '09, has been appointed Regents' Professor of Business Administration for the Spring 1959 semester at the University of California in Berkeley. Mr. Farr is a real estate consultant.

Arthur W. Harrington, C.E. '09, who has been district engineer for the US Geological Survey at Albany for more than thirty-five years, received the Distinguished Service Award of the Department of the Interior, the highest honor the Department can bestow, at ceremonies in Washington, D.C., September 5. He retired from the Survey last June after nearly forty-three years of Federal service. Mr. Harrington has served on several national committees on water resources which were responsible for policy decision on the development of state and national water resources. He also has been a director and vice-president of the American Society of Civil Engineers and chairman of a special committee that revised its constitution and by-laws.

Cecil Lezard, M.E. '24, is now the assistant editor of the British Engineering Journal. After graduating Cornell, Mr. Lezard became a consultant in South Africa and later in Argentina. Seventeen years ago, he moved to England where he became a pilot during World War II and flew bombers for about a year. Later, he had an advisory job with the Royal Air Force.

Benjamin M. Shaub, M.E. '25, M.S., Ph.D., is retiring as professor from Smith College, Northampton, where he spent many years and a distinguished career as a mineralogist. He will continue research and the writing of his book on New England mineral localities.

Donell D. MacCarthy, E.E. '26, M.E.E. '30, has been elevated to the grade of Fellow by the American Institute of Electrical Engineers. This is the Institute's highest grade.

Mr. MacCarthy is manager of voltage regulator engineering, power transformer department, General Electric Company. He was cited for "his contribution to overvoltage protective apparatus for electrical power systems."

Mr. MacCarthy has been with General Electric since 1930. He is the author of several technical papers and holds several patents dealing with lightning protection. He is also a member of the Massachusetts Society of Professional Engineers.

Gonzalo T. Abaya, M.E. '26, is president and general manager of the Cagayan Electric Power and Light Company, Inc., a public utility in the Philippines. He is also a past-president of the Philippine Association of Mechanical and Electrical Engineers and third vice-president of the Philippine Electric Plant Operators Association. Mr. Abaya is president of the Cornell Club of the Philippines.

Ernest C. Atkins, E.E. '28, a lieutenant colonel in the Air Force, is a member of General Yates's staff at Patrick Air Force Base in Florida of which Cape Canaveral is a part. Col. Atkins is chief of the research and development group.

Ronald C. Brown, M.E. '33, was appointed administrative assistant of the Product Development Laboratories, DPM Division, IBM Corporation, Poughkeepsie, New York. Mr. Brown previously was manager of the Administrative Services Department, Product Engineering, Kingston Military Products Division.

William D. Bailey, C.E. '24, has been admitted to partnership in the firm of Seelye Stevenson Value and Knecht, Consulting Engineers. Mr. Bailey was formerly an associate of the firm and will continue to act as manager of the Highway Engineering Division. The firm, located in New York City, will continue its practice of general consulting engineering under its former name.

T. H. Booth, M.E. '25, has been appointed president of the Frontier Bronze Corporation, Niagara Falls, New York. The company manufactures high strength aluminum and bronze castings.

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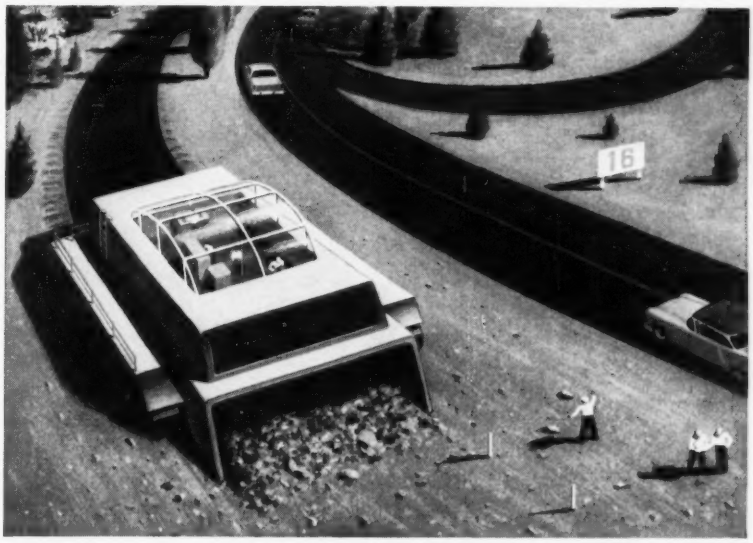

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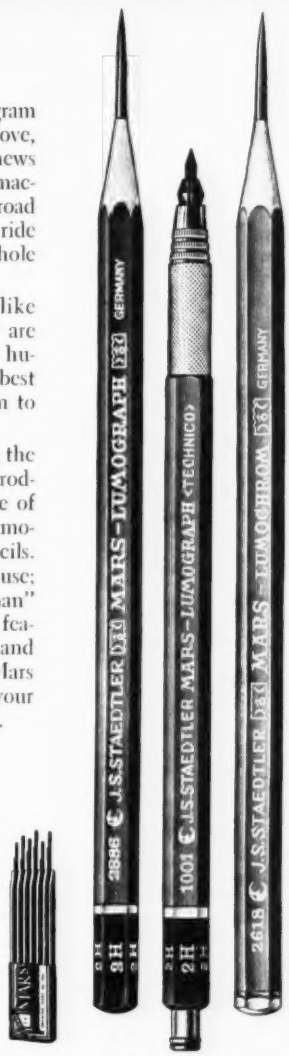

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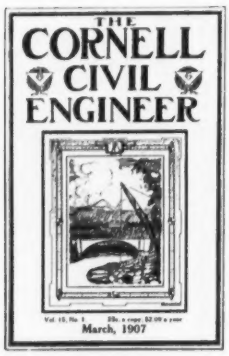

FIFTY YEARS AGO IN THE ENGINEER

Edited by J. F. Shapiro, ME '61

What we wish to point out is that the honor system, or any system of its character depends for its success upon that quality of the human race called honor, and the existence of that quality in every participant. Assuming that every man is evenly endowed with honor, yet such a peculiar thing is man, that his conscience needs continual prodding—a thing which the church continually does. The man with the true honor should rebel against the clause of the average system which states that he will report to a chosen number of his fellow men all cases of dishonesty which he notices. For, at one and the same time he is on his honor to act uprightly and yet feels the eyes of his fellow men ready to report any act of dishonesty. Granted that a system combining these two features is in operation and successful, is it not after all the fear of detection in wrong, which obtains this success? If we analyze thoroughly the process in the mind of a man who is sorely tempted to do something dishonest, we will find usually he can convince himself, and therefore his conscience, of the permissibility of one overstep. But, the actual "cribbing" itself in the eyes of his fellows requires the same old cunning and deceit. So, the real effectiveness of the honor system depends on fear of detection. And so it is in society. Man does not do wrong oftentimes, not because he knows it is wrong, but because he fears detection.

However the honor system so far as we have shown is still as effective as the proctor system. There is this added disadvantage. The demoralizing of a number of men can soon be accomplished by one. If one man has the courage to overstep the bounds there will be a number who will follow or else silently applaud his boldness. Oftentimes, pity, admiration for other abilities—athletic for instance, as well as personal fear, will combine to prevent a man from reporting an act of dishonesty coming under his notice. As a result even as a proctor system, the honor system is not effective, as the proctor is not disinterested nor impartial.

For these reasons, we feel that it would be wrong for Sibley College to adopt the honor system. Sibley College in eliminating final examinations, and adopting short and frequent "prelims" or quizzes has practically eliminated all dishonesty in examinations, and although the system is not perfect, still it is satisfactory. We might say in connection with the "prelim" that some of the professors have been in the habit of giving lengthy questions so that unless a man knows his subject he would not be able to make a passing grade, for the time is not sufficient to do much "cribbing." (*The Sibley Journal of Engineering*, April, 1909)

. . . One may think of the field of engineering as that of a large uncultivated field, a part very fruitful, one part hard to till, stones here and there to be removed and hills to be leveled off. The engineer's work then is similar to that of the farmer, in that he has many problems that keep coming up from time to time that need careful adjusting. The work is hard and entails responsibility of often far reaching importance, which because of material or ethical ground, on a part or on the whole of which may have a deep seated influence in the future development. Thus the calling of the Engineer not only needs a strong personality, but also high ideals, out of which are derived inspiration and power to accomplish his work. . . . One of the first requirements of a technical instructor should be that he cause the young student to love his chosen profession from pleasure in his work, and therefore develop the best that a man glories in; namely: an absolute satisfaction and delight in one's calling. He who loses himself in the pleasure of his work, gains inspiration and complete surrender, which enables him to do great things. (*The Sibley Journal of Engineering*, April, 1909)

One is here called to note the distinct difference between the professorship of the European university and that of the United States. Briefly, a professorship in engineering, doctoring, or law practice in Europe generally means that one has reached the highest pinnacle in his calling. That a professorship here in America is generally only a stepping stone to a higher field of labor or consulting practice is quite generally true. What the managing people of the University want to learn is to forget putting so much emphasis on equipment of laboratories, etc., and demand a better man to teach and lead the student. It is a remarkable fact that the freshman student at a European university comes in direct contact with the professors, while here it is only after a young man has wandered through a field of instruction of a few years' experience that he comes in direct contact with the professor. We need not deny that this is all too true. A point that is of interest is that the pay of a professor is not any greater in Europe than here, but his position socially and the honor conferred, make him all too glad to accept. (*The Sibley Journal of Engineering*, April, 1909)

Rolling snow on highways is practiced to some extent in Vermont, and is said to make hauling easier, to allow the use of sleighs longer than if not rolled, and to keep the roads open, since the snow blows off the smooth rolled surface. (*The Cornell Civil Engineer*, April, 1909)

The fire risk incurred by the practice of unrestricted smoking in Sibley College is a matter which warrants more attention on the part of Sibley Students than they are in the habit of bestowing upon it. If, as Dean Smith puts it, Sibley College exists in order that it may benefit all Sibley students, it seems to us that, for the common welfare, it would be well for the Faculty and undergraduates to arrive at a mutual understanding as to where, within the building, smoking might be indulged in, and where not.

Those who have given most thought to this subject have pretty generally reached the conclusion that there ought to be at least one place within the building where, between periods, or at any time, in fact, those who so desire could meet, chat, and smoke without restriction. It is needless to mention the promotion of good fellowship and other benefits that would be derived from such an institution.

The closest approximation to this we now have, is the club room in the Dome. To be sure, this room being also a library, reading, and study room, there is some doubt as to what effect unrestricted talking would have upon the desirability of the place for these purposes, however the matter almost seems to be adjusting itself now, for although the room is often crowded between hours, and there is much smoking and conversation at these times, nevertheless, during the larger part of the time, the room is quiet enough for study.

Such conditions having come about without any attempt at regulation, and as a natural development, it seems that, with a little co-operation on the part of the student body, there should be no difficulty whatever in reaching a satisfactory solution of the problem of preserving Sibley College from needless fore risk, and at the same time preserving the liberties of those who use the weed.–(*Sibley Journal*, January, 1908)

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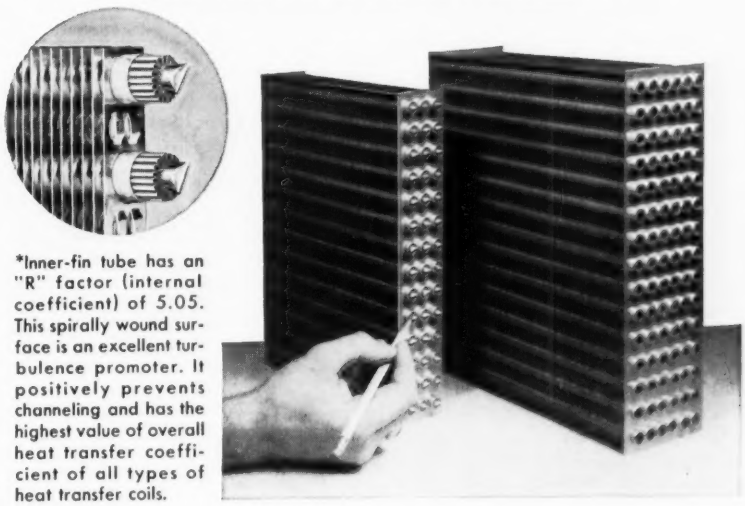

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STRESS *and* STRAIN . . .

Edited by D. J. Martin, EE '62

Being tired of plagiarizing from other sources, I have decided to plagiarize our own material. These jokes are taken from issues of "The Cornell Civil Engineer" which are at least twenty five years old. As you can see, humor has not changed. As a matter of fact, neither have many of the jokes.
—The Editor.

"What were your father's last words?"

There were no last words; mother was with him to the end."

March, 1931

• • •

The patter of tiny feet was heard from the head of the stairs. Mrs. Smith raised her hand, warning the members of her bridge club to be silent.

"Hush," she said softly, "the children are going to deliver their good-night message. It always gives me a feeling of reverence to hear them. Listen."

"Mama," came the message in a shrill whisper, "Willie found a bed bug!" **March, 1931**

• • •

"Those are my mother's ashes in the jar on the mantel."

"So she has passed to the Great Beyond?"

"Heck, no; she's just too lazy to look for an ash-tray."

March, 1931

• • •

"You drunken beast! If I were in your condition I'd shoot myself!"

"Lady, if you wash in my condishun you'd miss yershelf."

February, 1931

• • •

It was their first separation and he promised faithfully when he started in the morning on a twenty-mile automobile trip to another town that he would return in time for dinner at 7:00 o'clock, but he failed to arrive. At last the frantic bride sent telegrams to five of his friends living in towns that he might pass through, asking: "Is John spending the night with you?" The husband reached home at midnight with a broken automobile trailing behind the wagon that had brought him home. A few minutes later, one after another, the answers to the five telegrams arrived. Each one said: "Yes, John is spending the night with me."

The age of loyalty has not passed. February, 1931

• • •

Sign in the bathroom in a boarding house:

Please Clean Tub
After Bathing
Landlady

December, 1930

• • •

He—"Yes, I changed schools."

She—"Oh, I'm so glad. I never did like engineers, for they always leave blueprints on your neck."

November, 1930

• • •

In Boccaccio, it's frankness;
In Rabelais, it's life;
In a professor, it's clever;
In college humor, it's smutty.

November, 1930

• • •

Beau: "So you say your big sister sent you down to entertain me until she comes down?"

12-year old: "Yes, shall we turn on the radio and shake it up, or do you want to neck?"

• • •

Barber—"Sonny, how do you want your hair cut?"

Boy—"With a hole in the top like Daddy's. **October, 1929**

• • •

"What a unique town."

"Unique?"

"Yes, taken from the Latin, unius meaning one, equs meaning horse —one horse." February, 1930

• • •

He—"I've been reading statistics. Every time I breathe a man dies."

She—"Gosh! Why don't you use Listerine?" **February, 1930**

• • •

Judge—"Exactly how far were you from the spot when the accident occurred?"

Witness—"Eighteen feet and ten inches, your honor."

Judge—"How do you know it was exactly that distance?"

Witness—"Because I measured it, thinking some fool would ask me the distance." January, 1930

• • •

"I hate to see women doing men's work," mused the thoughtful engineer as he saw two slick-looking co-eds kiss each other.

March 1930

• • •

"Nurse," said the amorous patient, "I'm in love with you. I don't want to get well."

"Cheer up, you won't," she assured him. "The doctor's in love with me too, and he saw you kiss me this morning."

December 1929

• • •

Senior—"What will it cost me to have my car fixed?"

Garageman—"What's the matter with it?"

Senior—"I don't know."

Garageman—"Fifty-two dollars and sixty cents."

October 1930

• • •

"Gus," said Bill, as he caught up with him on the way back to camp, "are all the rest of the boys out of the woods yet?"

"Yes," said Gus.

"All six of them?"

"Yes."

"And are they all safe?"

"Yep," answered Gus, "they're all safe."

"Then," said Bill, his chest swelling, "I've shot a deer."

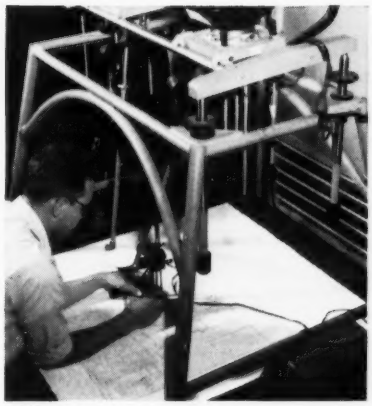
March 1931

• • •

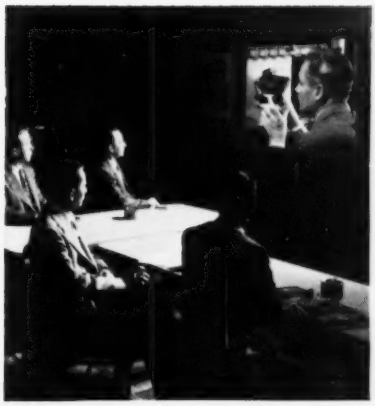
Murphy: "What's in your pocket?"

Pat (in whisper): "Dynamite. I'm waiting for Casey. Every time he meets me he slaps me on the chest and breaks me pipe. Next time he does it, he'll blow his hand off." **February 1933**

1 By setting templates of standard components on photo-sensitive paper and exposing it, hours of hand drafting are saved.



2 With this plotter, stereo aerial photos become contour maps, show highway routes, mineral-bearing formations, volume of coal piles.



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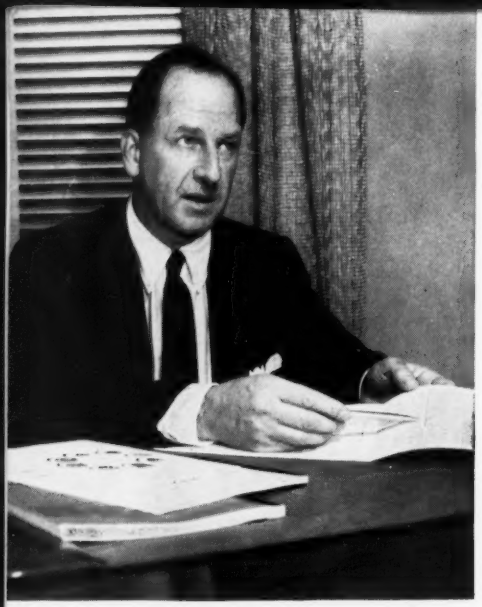

One of a series

Interview with General Electric's Hubert W. Gouldthorpe Manager—Engineering Personnel

Your Salary

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4 2

Although many surveys show that salary is not the prime factor contributing to job satisfaction, it is of great importance to students weighing career opportunities. Here, Mr. Gouldthorpe answers some questions frequently asked by college engineering students.

Q. Mr. Gouldthorpe, how do you determine the starting salaries you offer graduating engineers?

A. Well, we try to evaluate the man's potential worth to General Electric. This depends on his qualifications and our need for those qualifications.

Q. How do you evaluate this potential?

A. We do it on the basis of demonstrated scholarship and extra-curricular performance, work experience, and personal qualities as appraised by interviewers, faculty, and other references.

Of course, we're not the only company looking for highly qualified men. We're alert to competition and pay competitive salaries to get the promising engineers we need.

Q. When could I expect my first raise at General Electric?

A. Our primary training programs for engineers, the Engineering Program, Manufacturing Program, and Technical Marketing Program, generally grant raises after you've been with the Company about a year.

Q. Is it an automatic raise?

A. It's automatic only in the sense that your salary is reviewed at that time. Its amount, however, is not the same for everyone. This depends first and foremost on how well you have performed your assignments, but pay changes do reflect trends in over-all salary structure brought on by changes in the cost of living or other factors.

Q. How much is your benefit program worth, as an addition to salary?

A. A great deal. Company benefits can be a surprisingly large part of employee compensation. We figure our total benefit program can be worth as much as 1/6 of your salary, depending on the extent to which you participate in the many programs available at G.E.

Q. Participation in the programs, then, is voluntary?

A. Oh, yes. The medical and life insurance plan, pension plan, and savings and stock bonus plan are all operated on a mutual contribution basis, and you're not obligated to join any of them. But they are such good values that most of our people do participate. They're an excellent way to save and provide personal and family protection.

Q. After you've been with a company like G.E. for a few years, who decides when a raise is given and how much it will be? How high up does this decision have to go?

A. We review professional salaries at least once a year. Under our philosophy of delegating such responsibilities, the decision regarding your raise will be made by one man—the man you report to; subject to the approval of only one other man—his manager.

Q. At present, what salaries do engineers with ten years' experience make?

A. According to a 1956 Survey of the Engineers Joint Council*, engineers with 10 years in the electrical machinery manufacturing industry were earning a median salary of $8100, with salaries ranging up to and beyond $15,000. At General Electric more than two thirds of our 10-year, technical college graduates are earning above this industry median. This is because we provide opportunity for the competent man to develop rapidly toward the bigger job that fits his interests and makes full use of his capabilities. As a natural consequence, more men have reached the higher salaried positions faster, and they are there because of the high value of their contribution.

I hope this answers the question you asked, but I want to emphasize again that the salary *you* will be earning depends on the value of *your* contribution. The effect of such considerations as years of service, industry median salaries, etc., will be insignificant by comparison. It is most important for you to pick a job that will *let* you make the most of your capabilities.

Q. Do you have one salary plan for professional people in engineering and a different one for those in managerial work?

A. No, we don't make such a distinction between these two important kinds of work. We have an integrated salary structure which covers both kinds of jobs, all the way up to the President's. It assures pay in accordance with actual individual contribution, whichever avenue a man may choose to follow.

*** We have a limited number of copies of the Engineers Joint Council report entitled "Professional Income of Engineers—1956." If you would like a copy, write to Engineering Personnel, Bldg. 36, 5th Floor, General Electric Company, Schenectady 5, N. Y.** 959-7

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